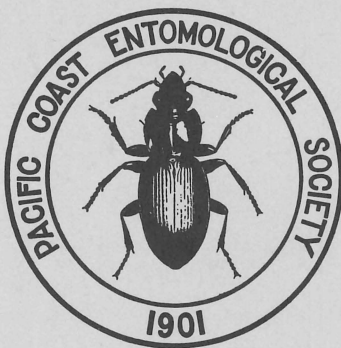


THE PAN-PACIFIC ENTOMOLOGIST



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A Morphometric and Revisionary Study of the Littoral Beetle Genus *Cryptadius* LeConte, 1852 (Tenebrionidae: Coleoptera)

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Abstract.—The tenebrionid genus *Cryptadius* LeConte occurs in littoral habitats of southern California and northwestern Mexico. Through a geographic study of character distribution and a morphometric analysis of population variation, the 9 nominal species of the genus are reduced to 3. *Cryptadius oviformis* Casey, *C. punctipennis* Casey and *C. curvipes* Casey are placed in synonymy under *C. inflatus* LeConte; this species occurs on the Pacific coast of Baja and southern California. *Cryptadius sinuatus* Blaisdell, *C. angulatus* Blaisdell, and *C. andrewsi* Berry are placed in synonymy under *C. tarsalis* Blaisdell; this species occurs on the gulf coast of Baja California. *Cryptadius sonorae* Berry, from the Sonoran coast, is retained as valid. *Cryptadius inflatus* is divided into 2 subspecies: *C. i. blaisdelli*, n. ssp. from Baja Sur, and *C. i. inflatus* from southern California.

A morphometric analysis of geographic variation among populations of *Cryptadius* was undertaken as a prelude to a taxonomic revision of the genus. These beetles inhabit the sandy coastal strands of California and northwestern Mexico where the shrubby littoral vegetation approaches the tidal limits. These tenebrionids are flightless and burrow in the sand beneath salt tolerant plants such as saltbush (*Atriplex* spp.) or pickleweed (*Salicornia* spp.), often where the sand is moistened by the high tides or ocean spray. Such habitats are separated by stretches of rocky shoreline, muddy estuaries and unstable, unvegetated beaches, environments unsuitable for *Cryptadius*. In essence therefore, these populations have a disjunctive but linear distribution along some 3000 km of coastline.

Cryptadius at present contains 9 species and has not been the subject of a modern revision. The genus was proposed by LeConte in 1852 to hold a new species, *inflatus*, based on a unique specimen from San Diego, California. Subsequently, this specimen was lost at sea while being sent to Europe for study. For its identity we rely on the authority of Horn (1874) and Casey (1890) who based their descriptions on specimens from the type locality. Casey (1907) redefined *Cryptadius* and proposed 3 new species, all from southern California. Casey distinguished his species primarily by the form of the body which ranged from "broadly-oval" to "oblong-oval," and secondarily by the density of surface punctation, though only in relative terms, i.e., more or less dense than in *inflatus*. Blaisdell (1923) remarked without elaboration that Casey's species were nothing more than *inflatus* and its phases. Blaisdell in his turn added 3 new species to the genus, all from the Baja California peninsula and constructed a key for their separation, later (1943) adding additional locality records. He emphasized differences in the shape of the pronotum, especially the posterolateral angles.

In recent times, Berry (1974, 1977) provided the first descriptions of male genitalia and named 3 new species, 2 from Sonora and 1 from Texas. The Texas species has since been removed to a distinct and separate genus (Thomas, 1984). Berry observed that Blaisdell's flippant dismissal of Casey's species, while possibly correct, should not be accepted without a thorough review of the species. The following report attempts such a review.

METHODS

In addition to specimens borrowed from museums, collecting trips were made to the beaches of southern California, Sonora, and the Baja California peninsula. Beetles were collected live by sieving sand beneath shrubs nearest to the shoreline, the specimens placed immediately into 70% ethanol for preservation. All measurements were made on pinned specimens to the nearest 0.05 mm with the aid of a graduated ocular on a dissecting, binocular microscope at a magnification of $14\times$. It was assumed that beetles of similar morphotype from a single locality were conspecific. At some localities different morphotypes were sympatric. Only localities for which there were at least 10 specimens available were included in the morphometric analyses. Males and females were not considered separately as no secondary sexual characters were found. The mean total body length of 36 females was 6.5 mm while that of 21 males from the same locality was 6.4 mm. This difference was not statistically significant at $P = 0.05$.

Basic statistical functions were performed on a Hewlett-Packard HP-65 programmable calculator. The Student-Newman-Keuls Multiple Range Test (Sokal and Rohlf, 1969) was used to compare sample means.

RESULTS AND DISCUSSION

A search for characters revealed the presence of 3 discrete forms or morphotypes of *Cryptadius*, each morphotype having a distinctive geographical distribution (Fig. 1). A pacific coast morphotype occurs from Point Conception in California to the tip of Baja California at Cabo San Lucas. A peninsula morphotype occurs on the gulf coast of Baja California, many of the gulf islands and on the northern coast of Sonora. A sonoran morphotype occurs on the coast of Sonora from Punta Peñasco south to Guaymas and at one known location on the Baja peninsula. The sonoran and peninsula morphotypes are thus sympatric over a part of their ranges. The 3 forms are distinguished by the shape of the pronotum, especially the posterolateral angles, the shape of the scutellum, and by a combination of other characters which are discussed in the keys and diagnoses that follow. Populations of these morphotypes were analyzed for morphometric heterogeneity.

The Pacific coast morphotype includes *Cryptadius inflatus* of authors and the species described by Casey but considered by Blaisdell to be "phases" of *C. inflatus*. Statistically significant morphometric differences are found among the different populations of this morphotype (Table 1) of which many are of single dimensions in a discordant pattern. A few differences were found to have a distinct geographic pattern. The overall size (both length and width) of the populations in the central part of the range are significantly smaller than those either to the north or the south (Fig. 2). This character reversal correlates with a reversed cline in humidity, the northern Baja coast being more arid than areas to the north or south (Wiggins, 1980). Whether or not there is a cause and effect relationship for

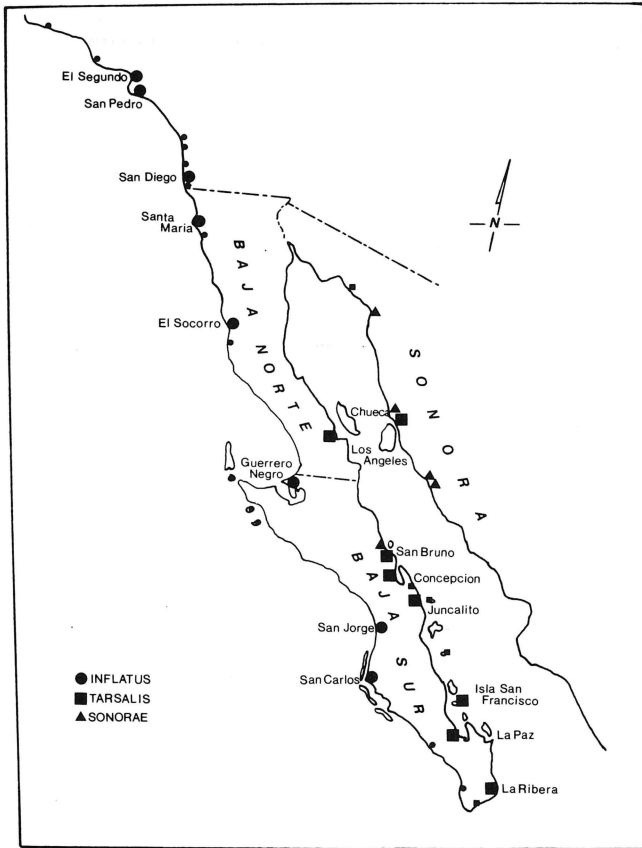


Figure 1. Distribution of *Cryptadius*. Localities included in morphometric analyses indicated by large symbols.

this correlation, the taxonomic significance of this variation is that it magnifies the distinctiveness of the southern populations.

A strong character divergence is found by comparing the proportions of the pronotum between populations from the pacific coast of Baja California Sur with those further north. In the southern populations the pronotal base is proportionately wider. Figure 3 shows the degree of divergence between the forms. While the difference is manifestly and statistically significant and involves a character which is important in distinguishing full species of many tenebrionids, there is still some overlap between the populations. Where the distributions of the populations converge, there is intergradation of the pronotal character. Since the populations cannot be further discriminated by supporting characters I consider these regional forms to be no more than races or subspecies of a single species. All of the Pacific coast populations are therefore assignable to *Cryptadius inflatus* LeConte, divisible into a northern and a southern subspecies.

The peninsula morphotype includes *Cryptadius tarsalis* Blaisdell, *C. sinuatus* Blaisdell, *C. angulatus* Blaisdell, and *C. andrewsi* Berry. While there is somewhat

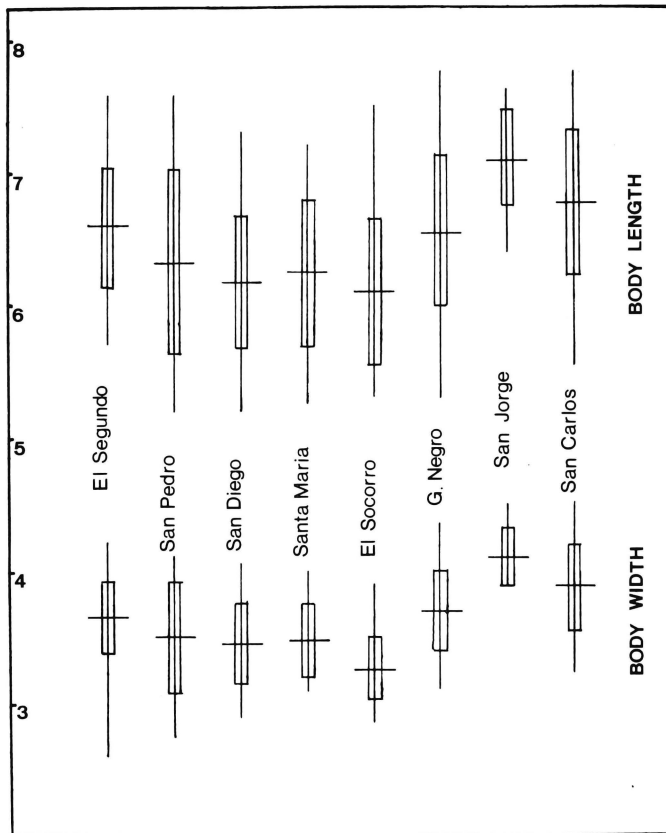


Figure 2. Size variation in pacific coast populations of *Cryptadus inflatus*; mean, range and standard deviation in mm.

less interpopulation variation within this morphotype than in the preceding, there are significant differences in several characters between populations, though not in a congruous geographic pattern. Most of the variation involves size rather than proportion, and it is ironic that the two populations which represent the extremes are from Bahia Concepcion, which Blaisdell named *C. sinuatus*, and Bahia Los Angeles, the type locality for his *C. tarsalis*. It can be seen (Table 2 and Fig. 4) that the size differences between these two populations are filled by the other populations, including *C. andrewsi* from northern Sonora and *C. angulatus* from Carmen Island, in a continuous manner. Since no discrete characters separate these populations, and no morphometric discontinuities are demonstrable, it must be concluded that this morphotype represents a single taxonomic entity. These populations are assigned to *C. tarsalis* Blaisdell.

The Sonoran morphotype is known from 5 localities on the Mexican mainland and one on the Baja California peninsula (Playa San Bruno). Table 3 shows that the degree of intrapopulation variation exhibited by this form is comparable to that seen in the preceding. While there are not enough localities represented in these data for the analysis of interpopulation variation to be definitive, the evi-

Table 1. Morphometric data for Pacific coast populations of *Cryptadius*, localities listed north-to-south. Means and standard deviations in mm. Means without blocks or followed by the same letter are not significantly different at $P = 0.05$.

	El Segundo	San Pedro	San Diego	Santa Maria	El Socorro	Guerrero Negro	San Jorge	San Carlos
<i>n</i>	26	26	62	14	46	86	10	24
Total length	6.58 ^b (±0.45)	6.32 (±0.69)	6.18 (±0.50)	6.24 (±0.55)	6.10 (±0.56)	6.56 ^b (±0.57)	7.11 ^a (±0.36)	6.78 ^a (±0.55)
Total width	3.65 ^b (±0.28)	3.50 (±0.41)	3.46 (±0.29)	3.47 (±0.28)	3.26 ^d (±0.24)	3.69 ^b (±0.30)	4.11 ^a (±0.21)	3.88 ^a (±0.33)
Pronotal width	3.04 (±0.27)	2.91 (±0.37)	2.86 (±0.27)	2.82 (±0.30)	2.69 ^b (±0.22)	3.09 (±0.26)	3.50 ^a (±0.15)	3.23 ^b (±0.30)
Posterior pronotum	2.77 (±0.25)	2.73 (±0.35)	2.64 (±0.26)	2.61 (±0.26)	2.51 ^c (±0.22)	2.93 ^c (±0.25)	3.38 ^a (±0.17)	3.13 ^b (±0.29)
Anterior pronotum	1.88 ^a (±0.15)	1.85 ^a (±0.22)	1.75 (±0.15)	1.75 (±0.17)	1.68 (±0.14)	1.92 ^a (±0.14)	1.98 ^a (±0.10)	1.88 ^a (±0.16)
Pronotal length	1.40 (±0.13)	1.35 (±0.15)	1.32 (±0.12)	1.31 (±0.15)	1.28 ^c (±0.11)	1.34 (±0.12)	1.48 ^a (±0.07)	1.40 (±0.11)
Elytral base	3.00 ^c (±0.26)	2.78 (±0.34)	2.75 (±0.25)	2.77 (±0.29)	2.59 ^d (±0.20)	3.15 ^b (±0.27)	3.51 ^a (±0.18)	3.25 ^b (±0.29)
Head width	1.64 (±0.14)	1.61 (±0.17)	1.55 (±0.13)	1.53 (±0.15)	1.47 ^b (±0.10)	1.61 (±0.11)	1.67 (±0.11)	1.67 (±0.14)

dence is consistent with the assignment of this morphotype to a single taxonomic unit. The only name available for this distinctive form is *Cryptadius sonora* Berry.

Figure 5 shows the character distribution of the pronotal morphometry which distinguishes the three types of *Cryptadius*. Thus evidence from both the morphometric analysis of continuous variation and the distribution of discrete characters supports the division of *Cryptadius* populations into three valid species.

Darkling beetle species are often restricted in distribution to distinctive habitats or substrates such as sand dunes, seashores or insular desert mountains. Owing to the disjunctive nature of these habitats the ranges of such species are mosaics of geographically separate demes. Isolation of these demes is intensified by the low vagility characteristic of these beetles. With the concomitant reduction in gene flow, morphological variation between demes sometimes approaches that of fully specific entities. Such vicariance is the fodder of incipient speciation, and the situation in *Cryptadius* may be indicative of a common pattern in the evolution of our North American Tenebrionidae.

KEYS AND DIAGNOSES FOR *CRYPTADIUS* AND ITS SPECIES

Genus *Cryptadius* LeConte, 1852

Diagnosis.—Flightless eurytemopines with body oblong-ovate in form, black to castaneous in color, length 5.0 to 8.2 mm. Epistomum truncate, feebly produced, often biemarginate. Gena strongly entering the eye anteriorly. Supra-orbital carina present. Outer apical angle of protibia with strongly produced, flattened, subacuminate process. Prosternum evenly deflexed behind coxae following their

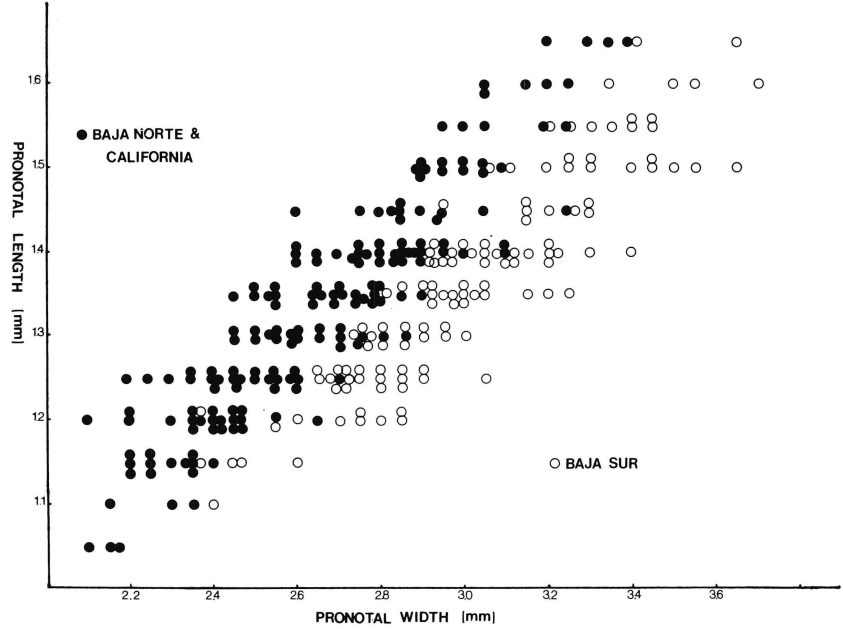


Figure 3. Pronotal proportions of *C. inflatus* expressed as mesial length vs. posterior width comparing the Pacific coast populations of Baja California Sur with those further north.

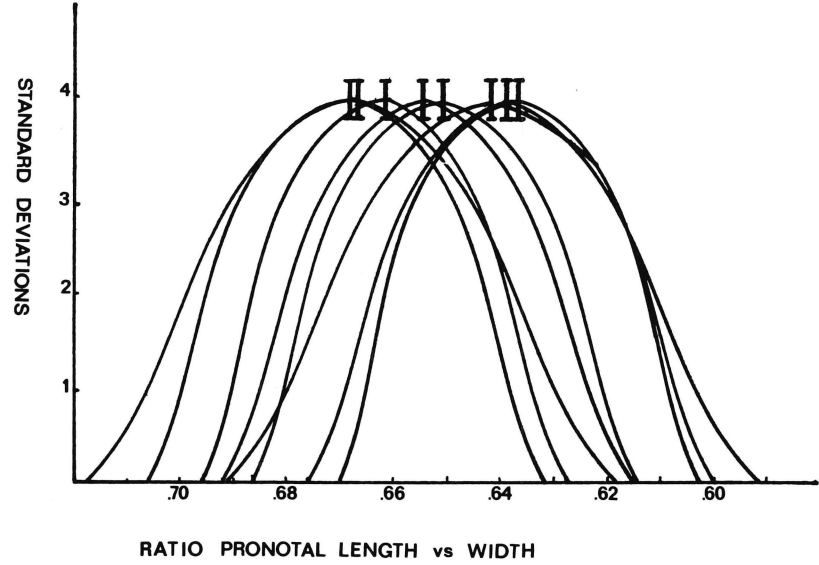


Figure 4. Variation in pronotal proportions expressed as ratio of mesial length vs. width for 8 populations of the peninsula morphotype. Area under each curve is 2 standard deviations.

Table 2. Morphometric data for gulf coast populations of *Cryptadius*,¹ localities listed from Sonora to tip of Baja peninsula. Means and standard deviations in mm. Means followed by the same letter are not significantly different at $P = 0.05$.

	Punta Chueca	Bahia Los Angeles	San Bruno	Bahia Concepcion	Playa Juncalito	Isla San Francisco	La Paz	La Ribera
<i>n</i>	38	44	16	31	16	17	39	34
Total length	7.43 ^a (±0.52)	7.03 ^b (±0.61)	7.39 ^a (±0.32)	7.83 ^c (±0.50)	7.13 ^a (±0.53)	7.30 ^a (±0.46)	7.56 ^a (±0.43)	7.57 ^a (±0.39)
Total width	3.76 ^a (±0.27)	3.52 ^b (±0.30)	3.78 ^a (±0.17)	3.90 ^a (±0.28)	3.75 ^a (±0.26)	3.78 ^a (±0.21)	3.76 ^a (±0.21)	3.70 ^a (±0.19)
Posterior pronotum	3.08 ^a (±0.22)	2.87 ^b (±0.27)	3.18 ^a (±0.16)	3.30 ^a (±0.22)	3.18 ^a (±0.25)	3.10 ^a (±0.19)	3.17 ^a (±0.21)	3.06 ^a (±0.16)
Anterior pronotum	1.99 ^a (±0.12)	1.94 ^a (±0.15)	2.11 ^a (±0.11)	2.24 ^b (±0.12)	2.07 ^a (±0.14)	2.04 ^a (±0.11)	2.05 ^a (±0.12)	2.06 ^a (±0.13)
Pronotal length	1.65 ^a (±0.10)	1.53 ^b (±0.13)	1.69 ^a (±0.12)	1.77 ^c (±0.12)	1.64 ^a (±0.10)	1.67 ^a (±0.12)	1.66 ^a (±0.09)	1.65 ^a (±0.09)
Ratio ant./post. pron.	0.646 ^a (±0.017)	0.678 ^b (±0.025)	0.664 ^c (±0.019)	0.679 ^b (±0.019)	0.651 ^{ac} (±0.025)	0.660 ^c (±0.018)	0.648 ^a (±0.019)	0.672 ^{bc} (±0.017)
Ratio L/W pronotum	0.536 ^a (±0.017)	0.533 ^a (±0.021)	0.532 ^a (±0.020)	0.537 ^a (±0.016)	0.518 ^b (±0.020)	0.539 ^a (±0.022)	0.526 ^{ab} (±0.023)	0.538 ^a (±0.017)

¹ Does not include *Cryptadius sonorae*.

contour, broadening posteriorly. Metasternum compact; distance between meso- and metacoxae less than distance from metacoxae to posterior border of first abdominal segment.

KEY TO THE SPECIES OF *CRYPTADIUS*

1. Posterolateral angles of pronotum obtuse, subangular to rounded 2
- Posterolateral angles of pronotum distinctly angular (gulf coast of Baja California and northern Sonora) *tarsalis* Blaisdell

Table 3. Morphometric data for *Cryptadius sonorae*. Means and standard deviations in mm.

	Punta Antonio	Punta Chueca	Guaymas	San Bruno	Bahia San Pedro ¹
<i>n</i>	1	8	21	6	1
Total length	5.80 —	6.18 (±0.34)	6.10 (±0.49)	5.99 (±0.39)	5.60 —
Total width	3.10 —	3.32 (±0.16)	3.23 (±0.29)	3.21 (±0.21)	3.20 —
Posterior pronotum	2.25 —	2.41 (±0.14)	2.38 (±0.20)	2.35 (±0.16)	2.25 —
Anterior pronotum	1.45 —	1.63 (±0.12)	1.61 (±0.13)	1.58 (±0.10)	1.55 —
Pronotal length	1.25 —	1.37 (±0.07)	1.32 (±0.12)	1.31 (±0.06)	1.30 —
Head width	1.30 —	1.37 (±0.07)	1.37 (±0.11)	1.36 (±0.07)	1.35 —

¹ Male paratype.

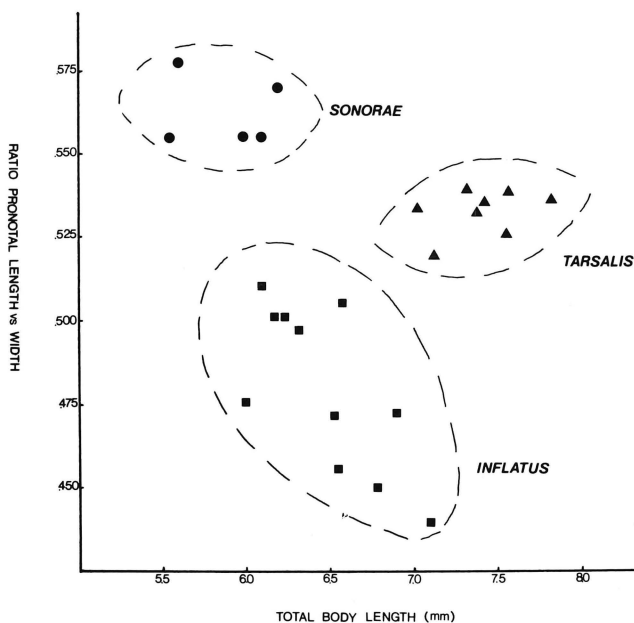


Figure 5. Scattergram of body morphometry showing clustering of mean values from different populations of *Cryptadius*.

2. Pronotum convex, narrow, embracing ventral thorax; antennae subclavate, apical segments gradually enlarged (gulf coast Sonora and Baja California) *sonorae* Berry
- Pronotum wide and depressed; antennae clavate to subcapitate, apical segments abruptly enlarged (Pacific coast of southern California and Baja California Norte) *inflatus* LeConte

Cryptadius inflatus LeConte, 1852

Cryptadius inflatus LeConte, 1852. Ann. Lyceum Nat. Hist. New York, 5:140.

Eurymetopon inflatum: Casey, 1890. Ann. New York Acad. Sci., 5:346.

Cryptadius oviformis Casey, 1907. Proc. Washington Acad. Sci., 9:328.

Cryptadius punctipennis Casey, 1907. Proc. Washington Acad. Sci., 9:328.

Cryptadius curvipes Casey, 1907. Proc. Washington Acad. Sci., 9:329.

Diagnosis.—Color varying from black to pale castaneous. Posterolateral angles of pronotum rounded. Punctures on disc of pronotum mostly coalescent. Setae on pronotal margin short. Setae on epipleural margin longer but seldom exceeding width of antennal club. Antennae subcapitate, last 3 segments distinctly more robust than preceding. Epistoma biemarginate. Scutellum about equally long as wide. Aedeagus (Fig. 8) straight in lateral profile, apicale only weakly flexed.

Cryptadius inflatus inflatus LeConte, 1852. Ann. Lyceum Nat. Hist. New York, 5:140.

Length usually less than 6.8 mm, averaging ca. 6.5 mm. Pronotum evenly convex; posterolateral angles broadly rounded. Ratio of mesial length to posterior width of pronotum 0.47 to 0.55 ($n = 183$).

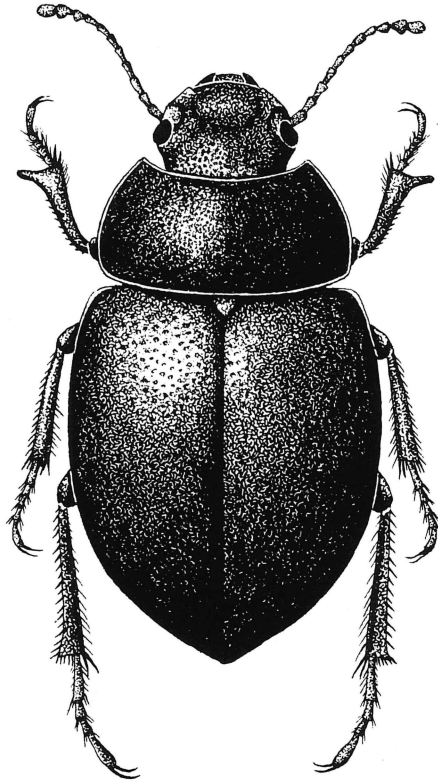


Figure 6. *Cryptadius inflatus blaisdelli*, new subspecies; dorsal facies.

Distribution and habitat.—Pacific coast of southern California from Pt. Conception and Santa Cruz Island south to El Rosario, Baja California Norte. Found on coastal strands in beach sand beneath littoral vegetation such as *Salicornia*, *Mesembrantherum* and *Abronia*.

***Cryptadius inflatus blaisdelli*, NEW SUBSPECIES**

(Fig. 6)

Length usually more than 6.7 mm, averaging ca. 7.0 mm. Pronotum depressed; posterolateral angles narrowly rounded, though not angular. Ratio of length to posterior width of pronotum 0.42 to 0.48 ($n = 125$).

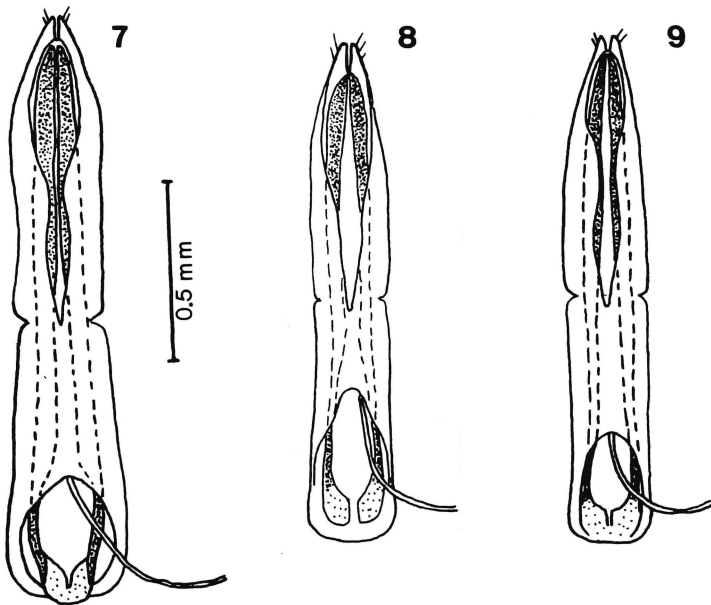
Distribution and habitat.—Pacific coast of Baja California Sur as far north as Guerrero Negro. Found on coastal strands in beach sand beneath littoral vegetation such as *Salicornia*.

Holotype.—♂; MEXICO, Baja California Sur, Las Barrancas. 5 Sept. 1983. D. B. Thomas & C. A. Olson. Deposited California Academy of Science.

Paratypes.—24 specimens labeled same as holotype. Deposited California Academy of Science, University of Arizona and collection of author.

Additional material examined from Baja California Sur: Guerrero Negro, San Jorge, San Carlos, Punta Conejo, Playa Migrino, Playa Los Cerritos, Isla Asuncion, Isla Natividad and Isla San Roque.

Comment.—The distributions of the two subspecies converge just north of Guerrero Negro. A series of specimens from Millers Landing, Baja California



Figures 7-9. Aedeagi of *Cryptadius* species, dorsal view. 7. *C. tarsalis*. 8. *C. inflatus*. 9. *C. sonorae*.

Norte, show intergradation in character and none are typical of either subspecies. The pronotum is depressed as in *blaisdelli*, but the body size is small as in *inflatus*. Further the pronotal ratio among these specimens varies from 0.45 to 0.51, which is intermediate to and overlapping the typical forms of the two races.

***Cryptadius tarsalis* Blaisdell, 1923**

Cryptadius tarsalis Blaisdell, 1923. Proc. California Acad. Sci., 12:212.

Cryptadius angulatus Blaisdell, 1923. Proc. California Acad. Sci., 12:210.

Cryptadius sinuatus Blaisdell, 1923. Proc. California Acad. Sci., 12:211.

Cryptadius andrewsi Berry, 1977. Proc. Entomol. Soc. Washington, 79:561.

Diagnosis.—Color black to castaneous. Posterolateral angles of pronotum distinctly angular; punctations on disc of pronotum mostly discrete. Scutellum much wider than long. Antennae subclavate, apical segments only gradually enlarging. Setae on epipleural margin short, length about equal to distance between them. Aedeagus (Fig. 7) distinctly bent in lateral view.

Distribution and habitat.—Gulf coast of the Baja California peninsula and northern Sonora. Also on Isla Santa Catalina, Isla San Francisco, Isla Carmen, Isla San Jose, Isla Espiritus Santo and Isla Coronado. Found on coastal strands in beach sand under *Salicornia*, *Mesembranthemum*, *Frankenia*, *Proboscidea* and *Atriplex*.

***Cryptadius sonorae* Berry, 1974**

Cryptadius sonorae Berry, 1974. Proc. Entomol. Soc. Washington, 76:175.

Diagnosis.—Color castaneous to pale castaneous. Pronotum proportionately narrow and convex, embracing ventral thorax; posterolateral angles obtuse, weakly angular; punctation on disc dense but shallow. Scutellum wider than long. Epi-

pleural and pronotal margin with long golden setae, longer than distance separating them, and those on epipleural margin longer than width of antennae. Epistoma feebly biemarginate. Antennae subclavate, the apical segments gradually enlarging. Aedeagus (Fig. 9) nearly straight in lateral profile, apex only weakly flexed.

Distribution and habitat.—Gulf coast of Sonora from Punta Peñasco to Huatabampo and at one location in Baja California Sur, Playa San Bruno. Occurs on coastal strands in beach sand under *Salicornia*, *Frankenia* and *Abronia*.

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The author wishes to thank Richard L. Berry, Ohio Dept. of Health, for his advice concerning synonymic problems in *Cryptadius*, David Kavanaugh, California Academy of Sciences, for arranging the loan of types of *C. sonorae*, *C. andrewsi*, *C. tarsalis*, and *C. angulatus*, and Carl Olson, University of Arizona for his special efforts in the field collecting of *Cryptadius* in Mexico. I also wish to thank Brett Ratcliffe and Mark Marcuson, University of Nebraska for providing facilities for this study and the drawing of *C. i. blaisdelli* respectively.

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***Dicymolomia julianalis* (Lepidoptera: Pyralidae) as an
Endoparasite of the Bagworm, *Thyridopteryx ephemeraeformis*
(Psychidae): Its Relation to Host, Life
History and Gonad Development**

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Abstract.—In central Oklahoma, larval *Dicymolomia julianalis* Walker (Lepidoptera: Pyralidae) attacks the eggs, larvae and pupae of the common bagworm, *Thyridopteryx ephemeraeformis* (Lepidoptera: Psychidae) at the rate of 21%, 7% and 12% respectively. Beside preying on the bagworm eggs, it burrows into the body of a living larva or pupa and lives on the host's inner organs for several months until pupation. *Dicymolomia julianalis*, therefore, is an endoparasite, as well as an egg predator of the bagworm. Twenty percent of those that had parasitized the immature stages of the host became adults, as opposed to 80% of those that had preyed on the eggs.

The microscopic eggs of *D. julianalis* aestivate during summer months to hatch in August–September, synchronous with the availability of host eggs and pupae. A larva consumes $\frac{2}{3}$ to $\frac{3}{4}$ of the eggs in a pupal case, leaving the rest to hatch in spring. There is as yet no fixed pupation behavior. Of the total of 1912 bags containing live eggs, larvae and pupae, 15% were affected by this organism, as opposed to 6% by several different species of hymenopterans.

The development of gonads in both sexes is described.

Like many other pyralid larvae, the larva of *D. julianalis* had been known as a general detritus feeder (Munroe, 1972). However, Gahan (1909), McCreary (1930), Balduf (1937), and Barrows (1974), after finding *julianalis* larvae in the fresh egg mass of the bagworm, described them as egg predators. Only the last mentioned author was not certain whether the eggs were eaten or crushed by the burrowing activity of the pyralid larvae. In 1981, I repeated these findings, confirming this species as an egg predator, but at the same time, I discovered “another” lepidopterous larvae, similar to those of *julianalis* but different in color and size, parasitizing the larvae and pupae of the same bagworm. I isolated these larvae for observation, but none of them pupated; all died after a few months. Toward the end of 1982, I found a larger number of the same larvae, and since there seemed little morphological difference between these and the *julianalis* larvae, I fed them with bagworm eggs after the larvae had reached the last instar within their original hosts. The emerged adults were identified as those of *Dicymolomia julianalis*, thus establishing a new status of this species as an endoparasite of *Thyridopteryx ephemeraeformis*.

Records of lepidopterans endoparasitic upon other lepidopterans are almost unheard of. This paper examines the host-parasite relationship between these two

Table 1. Details of the bagworm bags examined.

No. of empty male bags (due to emergence)	1284
No. of empty female bags (causes unknown)	17
No. of bags eaten by birds:	
♂ bags	332
♀ bags	196
No. of bags with unfertilized females	49
No. of bags with dead larvae (causes unknown)*	87
No. of bags with dead pupae (causes unknown)*	31
No. of bags with fresh eggs	887
No. of bags with living larvae	410
No. of bags with living pupae	615
Total no. of bags examined:	3908

* In these two groups, the bodies of larvae and pupae were whole; they contained no recognizable parasites or bore any holes on the body wall.

species of butterflies, as well as the ecological, biological, and anatomical aspects of *Dicymolomia julianalis*. I hope that this work may contribute more details to the existing knowledge of this microlepidoptera.

MATERIALS AND METHODS

Bagworms were collected once every week from juniper and arborvitae trees at 10 different sites in Norman from August 1981 to April 1983. The collected bags were then cut open and examined for parasites; those infested were individually isolated in small glass jars until emergence of the parasites. Exceptions were those collected in August and September, all of which were kept isolated in this way, because the pyralid larvae at eclosion were too small to be detected among the bagworm eggs, or in pupae and larvae. The total number of the bags thus examined was 3908 (Table 1). Aside from these, from May to August, some 400 immature larvae of various instars were also examined for possible parasites. Similarly, in order to find out the identity of those lepidopteran larvae found in bagworm larvae and pupae, the total of 80 such individuals (40 in larvae, 40 in pupae) were divided equally into 4 groups as shown below:

Group 1.—20 *julianalis* larvae left alone with their original larval hosts (control).

Group 2.—20 *julianalis* larvae singly transferred to bags containing fresh bagworm eggs, after reaching the final instar within the original larval hosts.

Group 3.—20 *julianalis* larvae left alone with their original pupal hosts (control).

Group 4.—20 *julianalis* larvae singly transferred to bags containing fresh bagworm eggs, after reaching the final instar within the original pupal hosts.

Emerged adults were released into a cage (30 × 30 × 30 cm) provided with a bagworm-infested arborvitae branch for mating and oviposition.

To study the development of gonads, 1–3 day old adults of both sexes were dissected under the stereoscopic microscope. In males: testes, vasa deferentia, vesicula seminales and accessory glands; in females, ovaries, oviduct, bursa copulatrix, spermatophores and receptaculum seminis, were crushed lightly between a slide and a cover glass and examined under the compound microscope.

Table 2. The frequency of *D. julianalis* larvae found in different stages of *T. ephemeraeformis* and the percentage that became adults.

	No. of bags containing live			
	Eggs	Larvae	Pupae	Total
	887	410	615	1912
No. of bags infested by <i>D.j.</i> larvae	189	30 (9 ♂, 21 ♀)	76 (38 ♂, 38 ♀)	295 (47 ♂, 248 ♀)
Infestation of <i>D.j.</i> larvae against original no. (%)	21.3	7.3	12.4	15.4
% of <i>D.j.</i> larvae that became adults	80	5	15	100

RESULTS

Host

Larval *Dicymolomia julianalis* attacks all stages except adult of the common bagworm, *Thyridopteryx ephemeraeformis* in various degrees depending on the sexes and the developmental stages of the host (Table 2).

The relationship between each stage of the host and the parasite will be examined separately.

(1) *Host-eggs*.—A batch of bagworm eggs is contained in a female pupal case and is protected by a “plug” consisting of shed female body hairs. *A. julianalis* larva enters an egg-filled pupal case from the opening made by the female host, and begins feeding on the eggs. As it grows, the larva molds the soft, yellow-brown hairs of the plug just mentioned into a tube which perhaps protects its occupant against cold during the winter months (Fig. 1A). As the larva continues feeding, sticking its head out of the tube after the manner of the bagworm larva, some more hairs are added to lengthen the tube which, at its final stage, may occupy almost the entire length of the pupal case. By the time the larva is fully grown, $\frac{2}{3}$ to $\frac{3}{4}$ of the eggs in the bag have been consumed, leaving the rest unmolested; therefore, a pyralid-infested bag still yields bagworm larvae in spring. In this connection, mention should be made that Gahan (1909) and McCreary (1930) stated that bagworm eggs were completely consumed, while according to Balduf (1937), the eggs were “reduced to various extent.” In my observations, no bags occupied by a single *julianalis* larva were found empty. Normally one bag contains only one *julianalis*, but in about 4% of the specimens examined, two individuals shared a bag. In such cases, either both larvae starved to death, or the one which had pupated first was devoured by the second, still in its feeding stage. The pyralid larvae that had fed on the host eggs were white and fat, in comparison to yellow and thin larvae that had parasitized the immature stages of the bagworm. Eighty percent of the egg feeders successfully became adults.

(2) *Host-larva*.—Only the last instar host-larvae are attacked, since in August–September, when the parasite eggs hatch, the great majority of the hosts have either pupated or oviposited leaving only a small number of last instar larvae. A newly eclosed *Dicymolomia julianalis* larva penetrates the body wall of the host

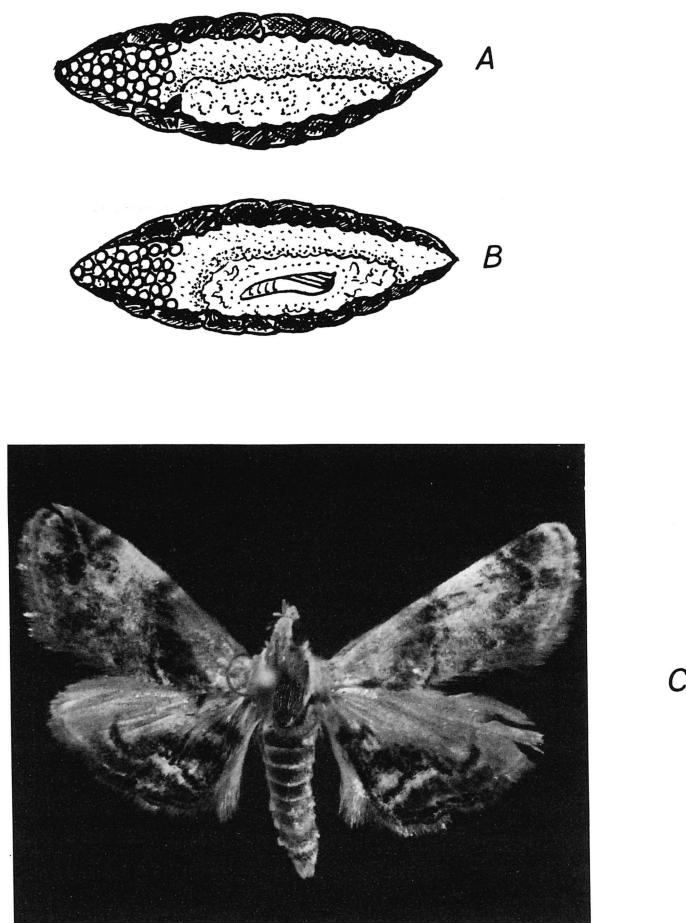


Figure 1. A. *Dicymolomia julianalis* larva in tube made of host body hair, feeding on bagworm eggs. B. Pupa in sealed larval tube. Note the remaining host eggs. C. Adult female (wing span: 10 mm).

and consumes all the fat and inner organs in 5–6 months, depending on the size of the host (female bagworm larvae are larger than male larvae; also, the well nourished are considerably larger than the undernourished). The parasite may then pupate inside the empty larval cuticle of the host without spinning a cocoon, or chews an irregular hole through the host's body wall, emerges, constructs a silken cocoon and pupates in the bag. Only 5% of those which had parasitized bagworm larvae became adults. The rest, upon emerging from the hosts, spun flimsy "tents" inside the bags and remained there as such for as long as 4 months. These larvae progressively became thinner and weaker, turned brownish and eventually died, but if such larvae were transferred to bags containing fresh eggs soon after they reached the last instar, then 70% reached adulthood as opposed to 5% in the control (see Methods).

(3) *Host-pupa*. — The manner of host-pupa parasitization and pupation are similar to those just described in the host-larva. Fifteen percent of this group succeeded

in becoming adults (6.5% emerged from male pupae, 8.5% from female pupae), as opposed to 80% in the egg-feeding group. The reason why more females than males are attacked is that while winged males vacate their bags immediately after emergence, vermiform females remain in them until oviposition is completed. Some of the parasites which had developed into adults on this diet consumed not only the inner organs, but also the entire exoskeleton of the host. At least one even fed on its own excretory pellets so that the interior of the host bag was literally empty except for the pupal case of the emerged parasite. If the pyralid larvae which would not pupate after consuming their pupal hosts were given bagworm eggs, then they continued development, pupated and 90% became adults as compared to 15% in control (see Methods). This fact indicates that the arrested development of the parasites was due mainly to a nutritional deficiency.

Population

The occurrence of *Dicymolomia julianalis* populations was restricted largely to 3 of the 10 collection sites. In general, bagworm-infested juniper and arborvitae trees in isolated, undisturbed fields had far larger pyralid population concentration than those near human dwellings or roads. In favorable localities, the proportion of the bagworms affected by this organism ranged from 13 to 20%.

Pyralid larval populations appear first during August–September when bagworm eggs become available, and reach a maximum from October to the following April during which host eggs hibernate. The minimum period is from late May to late July when only immature host-larvae are present in the wild. Of the total of 1912 bags containing live eggs, larvae and pupae, 15% were affected by this parasite (Table 2) as opposed to 6% by other endoparasites consisting of 3 species of ichneumonids and 2 species of chalcids.

Life History

Eggs.—Eggs are microscopic, measuring 0.5 mm long and 0.3 mm wide at center. They are yellowish-white and flatten soon after deposition, clinging to the substrate. These eggs aestivate from April–May to August–September, a period of some 4 months.

Larvae.—Newly eclosed larvae are only about 1 mm long. No morphological adaptation to the parasitic life is apparent: all 3 pairs of thoracic, as well as 5 pairs of abdominal legs with characteristic hooks are present. Larvae grow to 10 mm long in 5–6 months after several (5–6) molts.

Pupae.—The larval tube made of host hairs mentioned earlier is open on both ends. Later, however, a last-instar larva may close the openings and convert it into a cocoon in which to pupate (Fig. 1B). Some 80% of the pupae of *julianalis* found among host-eggs were inside such cocoons. As to the remaining 20%, some emerged from the host-puparia and constructed their own silken cocoons within their host-bags, while a few made no cocoons at all, but lay “naked” under the host-puparia or in some other concealed niches in the bags. Thus the pattern of pupation varies. Pupae are able to move their abdominal segments vigorously when disturbed. Pupal period lasts from 14–26, an average of 21 days.

Adults (Fig. 1C).—Adult emergence occurred as follows: 3% in February, 15% in March, 50% in April, and 32% in May (sample size: 295). Sixty percent of the parasites became adults before the eclosion of the host larvae, while 40% did so

after eclosion. Of the latter group, 20% emerged successfully; the rest were partly or completely eaten as pupae by the eclosed bagworm larvae. Most of these victims were without cocoons; some had hair-cocoons which were penetrated by the host-larvae. Newly eclosed bagworm larvae are normally vegetarians, but turn facultatively carnivorous whenever opportunities arise; they also devoured other dead insects including the adults of their own species when these were experimentally provided.

Adults are sexually mature at emergence. The sex ratio was 44% males and 56% females; this ratio coincided with that of the bagworm bags collected at random from the field. Fifty-five percent of the caged females mated soon after emergence; this figure could have been higher, if the first nine adults that emerged had included males among them. Eggs were laid on the surfaces of the bags and wooden frames of the cages. Adult life span did not exceed 2–3 days in both sexes.

Development of Gonads

Male.—The structure of the male reproductive system is shown in Figure 2. It is almost identical with that of *Maruca testulalis* (Kaufmann, 1983); the only morphological difference is that in *julianalis*, the vas deferens consists of 3 bulbous parts instead of 1. Testes are comprised mainly of encysted spermatozoa and those that have just been freed from the cysts, the individual spermatozoa of which, therefore, are still tightly held together at this stage (Fig. 2Bb). The spermatozoa of this species (Fig. 2Ba) are 2–3 times the length of those of *Maruca testulalis*. Free spermatozoa develop only in the third bulb (Fig. 2A) of the vas deferens. This bulb also contains encysted forms beside free spermatozoa (Fig. 2Bc) both of which are then transferred to the vesiculum seminis. Due to the secretion received from the paired accessory glands, vesicula seminales as well as the third bulbs of the vasa deferentia are prominently white in color. It is probable that without this accessory gland secretion, the free stage of the spermatozoa does not develop. The unpaired accessory gland contains an opaque material in the upper part, and milky white, granular substance in the lower part, the diameter of which is twice as large as that of the upper part. Both of these secretions together with spermatozoa form the spermatophore in females.

The development of free spermatozoa occurs within the first 24 hours after emergence, in comparison to 4–5 days in *Maruca testulalis* (Kaufmann, 1983). This is probably because the adult life span of this species is limited to 2–3 days, while that of *testulalis* covers 12 days.

Female.—The female reproductive system of *julianalis* differs from that of *testulalis* in the following features, namely: (1) ovarioles have no terminal filaments, (2) seminal duct arises directly from bursa copulatrix, (3) bursal gland lies immediately below bursa copulatrix to which it is directly connected without any duct, and (4) both bursa copulatrix and bursal gland are enveloped in a common, thin, transparent outer sac (Fig. 3A).

Ovaries contain mature ova at emergence; each of the 4 ovarioles contains about 25 eggs and therefore, the total number of eggs per female is $2 \times (25 \times 4) = 200$. However, the number of mature eggs at any one time is about 80.

The spermatophore of this insect consists of a round sperm sac and a tube, resembling the early stage of a tadpole (Fig. 3C1). When fresh, this entire structure is pearly white. A single spermatophore occupies the entire cavity of the bursa

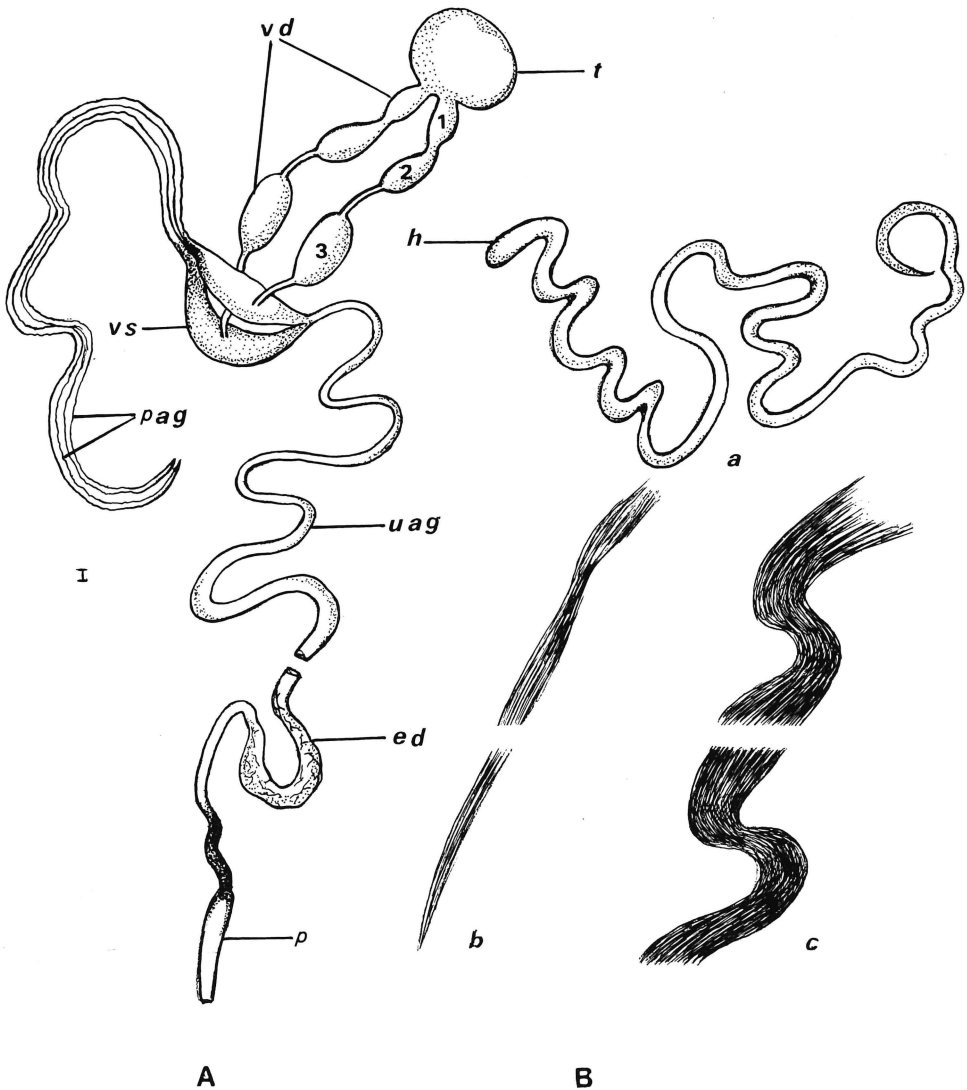


Figure 2. Male reproductive system. A. Entire system. t: testes, vd: vas deferens, vs: vesiculum seminis, pag: paired accessory glands, uag: unpaired accessory gland, ed: ejaculatory duct, p: penis. B. a: testicular cyst, h: head, b: spermatozoa immediately after being freed from cyst, c: free spermatozoa.

copulatrix. Unlike in *Maruca testulalis*, there is only one chitinous rod lying on the side of the seminal duct of the bursa (Fig. 3C3). When the muscular wall of the bursa contracts, this stout rod presumably squeezes the spermatophore between it and the opposite wall of the bursa, and in so doing, the spermatozoa are flushed out through the seminal duct and reach the receptacula seminis via seminal canal (Fig. 3B). An empty spermatophore quickly shrinks and 3 days after emergence, only a small residual body is seen in the seminal duct adjacent to the bursa (Fig. 3C3). As in *testulalis*, during the process of fertilization at vestibulum, some

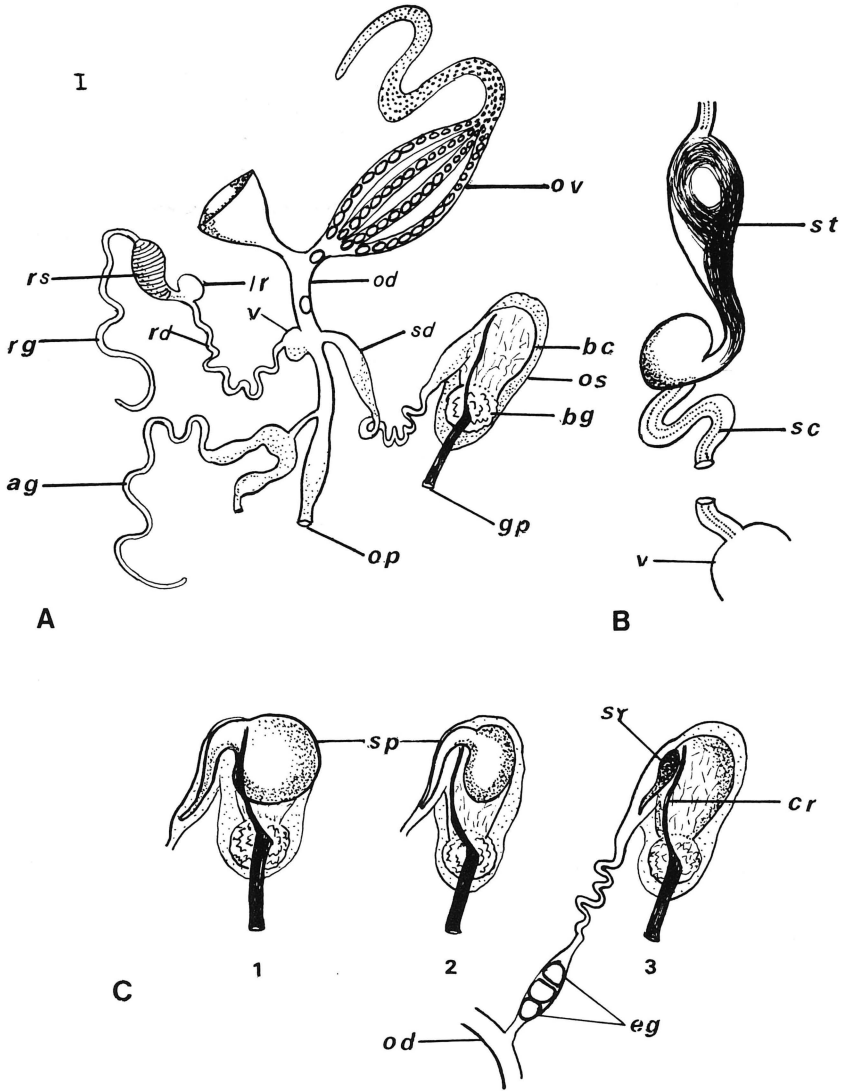


Figure 3. Female reproductive system. A. Entire system. ov: ovary with eggs, od: oviduct, sd: seminal duct, bc: bursa copulatrix, os: outer sac, bg: bursal gland, gp: gonopore, v: vestibulum, rs: receptaculum seminis, lr: lagina receptaculi, rd: receptacular duct, rg: receptacular gland, ag: accessory gland, op: ovipore. B. Receptacular system. st: spermatozoa, sc: seminal canal. C. Bursa copulatrix with spermatophore. sp: spermatophore, sr: residue of spermatophore, cr: chitinous rod, eg: stray eggs in seminal duct.

of the descending eggs get caught in the seminal duct; one such stray egg is common, but as many as 3 have been observed (Fig. 3C3).

DISCUSSION

Where bagworms are locally abundant, especially in quiet, undisturbed fields, the larvae of *D. julianalis* are also concentrated. From late August to September,

when *julianalis* eggs hatch, the bagworm populations in central Oklahoma roughly consist of 65% eggs, 25% pupae, and 10% larvae. Consequently, chances are that the largest number of the newly eclosed *julianalis* larvae find bags containing eggs followed by those with pupae, while those that encounter bags occupied by larvae will be the smallest numerically. Since the eclosion of this pyralid larvae is synchronous with the availability of bagworm eggs, feeding of the eggs by *julianalis* larvae is no more opportunistic than finding the bags filled with eggs. Moreover, *D. julianalis* larvae show an evolutionary trend of adaptation for egg predation such as the construction of protective tubes around their body, and the conservation of a part of the host eggs which, no doubt, contributes to the survival not only of the host species, but also of the predator itself. Such predation is clearly very different from that of other carnivorous butterfly larvae including those of *Spalgis epius* (Lycaenidae) which prey on coccids, or several other lycaenid larvae of similar habits (Clark, 1926).

As to those *julianalis* larvae which happen to enter the bags containing living larvae or pupae, it is a form of parasitism, since they live within the living hosts at the expense of the hosts' body fat and inner organs for their sustenance for the period of some 6 months—the definition of parasitism given by Brues (1946).

Many years ago, I worked on the biology of several different species of Tenebrionidae in Israel. Up to that time, these beetles were thought to live mainly on debris such as dry and decaying plant materials and excrement (Bodenheimer, 1935). My breeding experiments showed, however, that those larvae which fed on dead or living insects and other animal food developed faster with only small mortality than those which fed on both insects and debris. The larvae which were given only debris never pupated, but remained as "permanent" larvae (Kaufmann, 1969). In nature, these tenebrionids feed on debris when there is no other choice, but when an opportunity arises, they eagerly eat other animals. Perhaps the same can be said about *D. julianalis*. Gahan (1909) was informed that larval *D. julianalis* had been known as a scavenger of the common *Typha*, or cat tail. Munroe (1972) describes this species as a detritivor like many other pyralid larvae. The crucial question is: can they develop on detritus only? My own figures show that only 5% of *julianalis* larvae which parasitized bagworm larvae became adults. Yet, these hosts were alive, not dead, at the time they were attacked. If *julianalis* larvae fed exclusively on detritus, their chances of reaching adulthood could be very slim. At any rate, the feeding of bagworm eggs must have been going on for quite some time—long enough to develop the characteristic feeding behavior I have described. Be that as it may, whether the egg-, larvae-, and pupae-feeding of this pyralid should be regarded as a form of predation, parasitism, or both, depends mainly on the opinion of the entomologist. In nature, especially among insects, clear-cut distinctions between the two simply do not exist because of an intergrading.

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**Studies of Nearctic *Rhyacophila* (Trichoptera: Rhyacophilidae):
Synopsis of *Rhyacophila nevadensis* Group**

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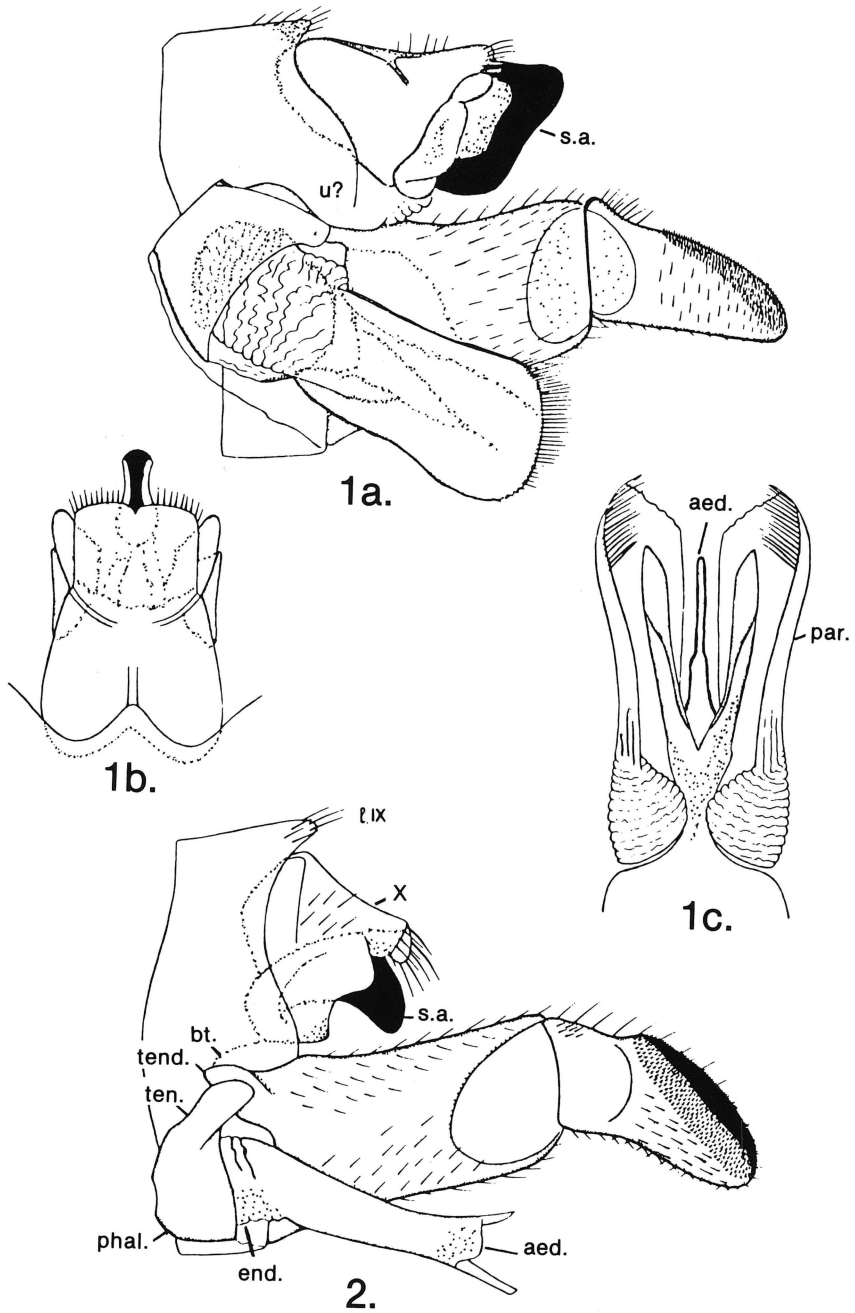
Abstract.—Members of the *Rhyacophila nevadensis* group are restricted to a few montane regions of California, Oregon, and Washington. The group contains three species: *R. nevadensis*, *R. vaefes*, and *R. jewetti*. A diagnosis and figures are presented for the males and females of each species. I am not able to separate the larvae of the three species. The larva of *R. vaefes* is described and figured.

This is the third in a series of papers to provide figures and descriptions of previously undescribed larvae in species groups of nearctic *Rhyacophila*. Wold (1974) in an extensive but unpublished Master's thesis described the larvae of many species; I have, however, independently established the identity of the larvae that I am describing. Initially I intended to include only larval descriptions. Often, however, as in this paper, it seems appropriate to also include notes on adults.

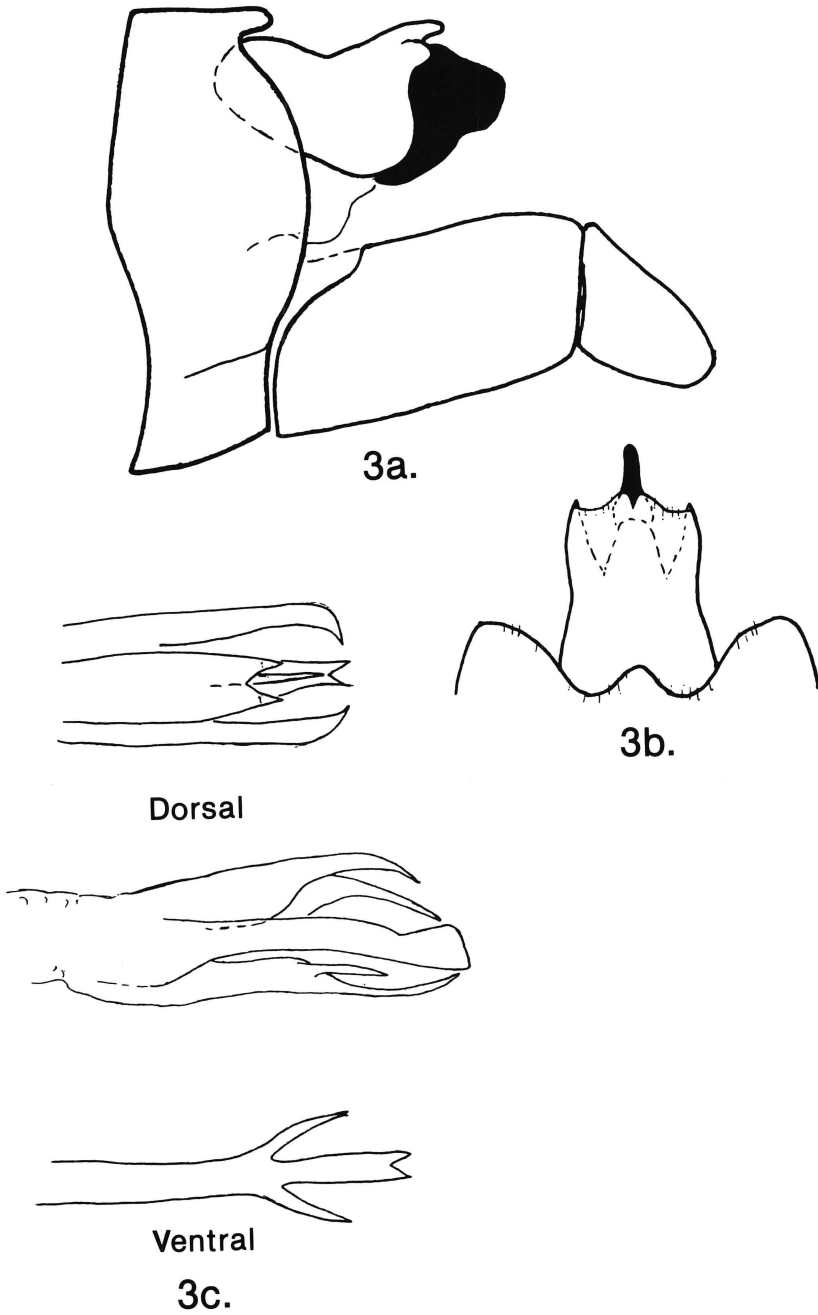
The *Rhyacophila nevadensis* group contains three closely related species that are confined to the Coastal, Cascade and Sierra Nevada mountains of western North America. *Rhyacophila jewetti* Denning is known only from a few locations in Oregon; *R. nevadensis* Banks is recorded from the Sierra Nevada Mountains of California and Nevada and the southernmost peaks of the Cascade Mountains in California, and *R. vaefes* Milne is the most common and widely distributed species and occurs in British Columbia, Washington, and Oregon.

Larvae of *R. vaefes* are most common in slow portions of 1st and 2nd order streams 3 to 10 m wide and less than 1 m deep. Thut (1969) and Wold (1974) discussed some aspects of *R. vaefes* biology. Thut found that *R. vaefes* larvae were omnivorous, "About 40% of the ingested material was plant (particularly diatoms), 40% animal, and the remainder detrital . . . Acari were fed upon in considerable numbers, and Plecoptera nymphs were not fed upon at all." Life history data compiled from records from over the range of *R. vaefes* are confusing; periods of growth probably relate to specific habitat temperature regimes. Adults are found from April to October at different locations throughout its range. Evidence indicates 3rd to 5th instar larvae are the most common overwintering stages. Although they are occasionally abundant, larvae of *R. nevadensis* and *R. jewetti* are infrequently collected and both of the species exhibit rather localized distributions.

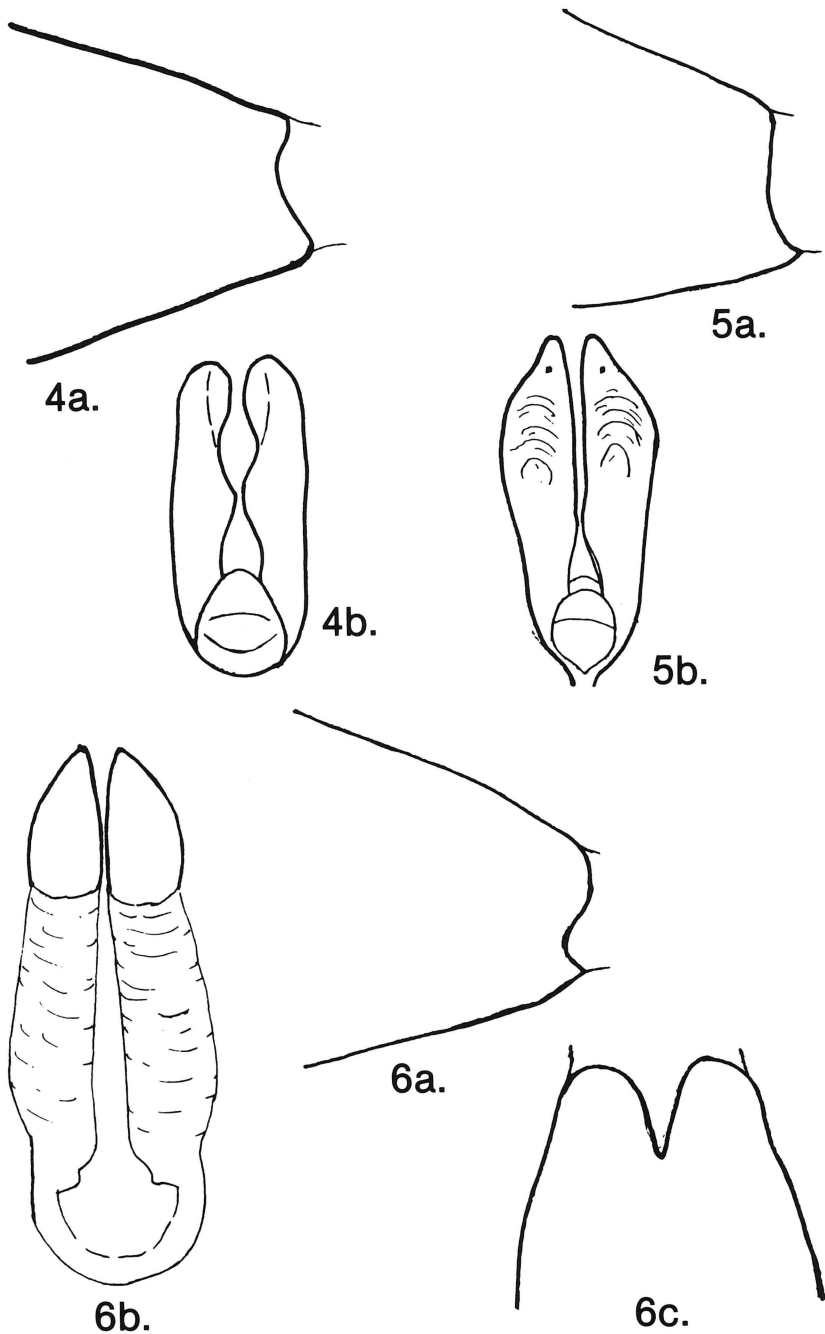
Ross (1956) placed the *nevadensis* group with the Nearctic *vofixa* group, for which the larvae are still unknown, and the Palearctic *tristis* group in branch 2 of his group phylogenetic diagram. He felt that they were rather primitive in nature and had not modified much from the original *Rhyacophila* type and stated, "As it seems to have no known close relatives, the *nevadensis* group appears to



Figures 1, 2. 1. *Rhyacophila vaefes* male; 1a, lateral view; 1b, Xth segment, dorsal view; 1c, phallic apparatus, ventral view. 2. *Rhyacophila nevadensis* male, lateral view. Figures 1 and 2 from Schmid, 1970.



Figures 3–6. 3. *Rhyacophila jewetti* male; 3a, lateral view; 3b, Xth segment, dorsal view; 3c, phallic apparatus. 4. *Rhyacophila vaefes* female; 4a, VIIIth segment, lateral view; 4b, vaginal apparatus. 5.



Rhyacophila nevadensis female; 5a, VIIIth segment, lateral view; 5b, vaginal apparatus. 6. *Rhyacophila jewetti* female; 6a, VIIIth segment, lateral view; 6b, vaginal apparatus; 6c, VIIIth segment, dorsal view.

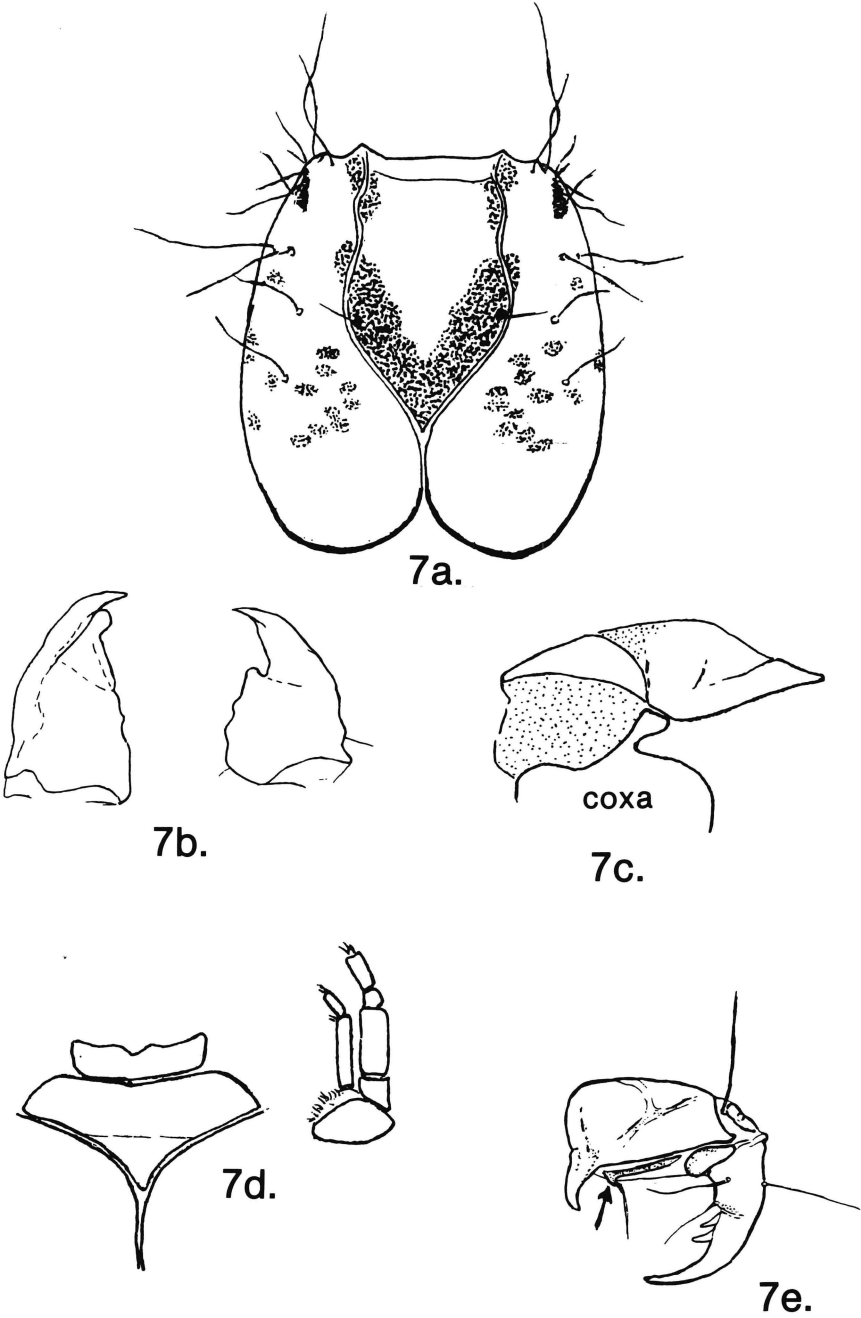


Figure 7. *Rhyacophila vaefes* larva; 7a, head, dorsal view; 7b, mandibles; 7c, propleuron; 7d, submentum and maxillum; 7e, anal proleg.

be another relict group confined to a single series of mountain ranges." Schmid (1970) did not place this group with any assemblage and listed it as having uncertain status. Both Ross and Schmid confined their analyses to adult males. Larvae of the *tristis* group from Europe do not reveal close affinities with those of the *nevadensis* group.

Larvae of the *nevadensis* group do little to clarify their relationships to other assemblages, at least when only Nearctic species are considered. As expected, they exhibit a mixture of apparently plesiomorphic and apomorphic character states. Although it is not my intent to discuss character states and their polarity until later in this series of papers, a few comments relative to the *nevadensis* group are in order here. The anal proleg of the *nevadensis* group is simple and very similar to what I consider the basic rhyacophilan plan, but it does exhibit a modification that is seen in no other Nearctic larvae. This apomorphy is that the small sclerite at the base of the ventral setae (Fig. 7e) is elongated into a distinct sclerite. I have seen larvae from Asia that have a similar but more complex development of this sclerite. The trochantin of the *nevadensis* group is similar to those of several other larval groups and is not produced into a digitate process. I consider the lack of a digitate trochantin to be an apomorphy. The submentum and other maxillo-labial structures seem little modified and most certainly are plesiomorphic. The chaetotaxy likewise gives no clues. Therefore, until we are able to examine larvae of the entire genus, particularly the Asian fauna, the affinities of the *nevadensis* group must remain in doubt. I follow Schmid (1970) and consider it of uncertain status.

DIAGNOSIS

R. nevadensis group

Males are readily recognized by the enlarged anal sclerite (Figs. 1–3), which has a large posterior keel and a flared base. The Xth tergite is simple, surrounding the base of the anal sclerite with a simple lobe on each side. The phallic apparatus is quite different in each of the three species, much more so than would normally be expected in closely related forms of *Rhyacophila*. The phallus varies from most complex in *R. jewetti* (Fig. 3c) with lateral, dorsal and ventral processes to very reduced and fused in *R. nevadensis* (Fig. 2).

Females (Figs. 4a, 5a, 6a) have a rather unmodified VIIIth segment in the shape of a truncated cone with the posterior margin in lateral view roundly concave to quadrately emarginate (in dorsal view the posterior margin is narrowly emarginate in *jewetti* only). The vaginal apparatus (Figs. 4b, 5b, 6b) is composed of two thick lateral pieces and varies from short in *R. vaefes* to elongate and rugose in *R. jewetti*.

Larvae can be immediately separated from all other Nearctic species by the anal proleg. The small sclerite at the base of the ventral seta is greatly developed and extends along the ventral margin of the large lateral sclerite (Fig. 7e). Additionally, larvae have a "paddle" shaped mesal tooth on the left mandible (Fig. 7b). Wold (1974) incompletely described the larva of *R. vaefes*.

R. vaefes Milne, 1936

Male.—In lateral view (Fig. 1) anal sclerite projecting posteriorly well beyond Xth tergite, only base of anal sclerite surrounded by Xth; in dorsal view anal

sclerite with slightly expanded apex. Phallic apparatus with two sets of lateral processes, the outermost large and spatulate.

Female.—VIIIth segment (Fig. 4a) more or less a truncate cone, posterior margin roundly concave. Vaginal apparatus (Fig. 4b) sclerotized; lateral pieces with apices evenly rounded, mesal margins sinuate.

Larva.—Length mature larva 16 mm. Head (Fig. 7a) slightly longer than wide, widest medially narrowing to the front; cream to light tan colored; dorsum with a dark "V" shaped maculation on frontoclypeus, roughly following the ecdysial line; muscle scars distinct, their number and position variable; venter generally cream colored, darker toward anterior margin, muscle scars indistinct. Mandibles as in Figure 7b, left mandible with a single acute apical tooth and a "paddle" shaped subapical tooth that arises from the anterior part of the mesal blade; right mandible with a single acute apical tooth (occasionally there is also a very small subapical dorsal tooth); apical teeth of mandibles frequently worn and blunt, probably as a result of their somewhat unusual diet. Maxillo-labial structure as in Figure 7d; maxillary palpi with 2nd and 4th segments 1.5 to 2 times longer than 1st and 3rd segments respectively; glossa elongate, cylindrical, normal for genus; submentum separate from ventral apotome, entire, roughly rectangular, anterior margin concave with a median notch.

Thorax without gills. Prothorax with notum cream colored, muscle scars darker, forming an indistinct dark maculation along the posterior half of the ecdysial suture and in the postero-lateral quadrants; posterior margin and posterior half of lateral margins black. Trochantin (Fig. 7c) not produced into a digitate process. Tibial setae 1 and 4 setiform, 1 longer than 4 (setal numbers follow Williams and Wiggins, 1981). All thoracic legs similar.

Abdomen without gills or other specializations. Setae 2, 3, 4, 5 on VIII arise from a common slender sclerite.

Anal proleg (Fig. 7e) simple. Lateral sclerite with a large, curved, slightly acute basoventral hook extending free from membrane; posterior angle not produced into an apicolateral spur; "Y" shaped suture with long stem of "Y" extending from postero-dorsal to antero-ventral angle. Ventral sole plate large; dorsal plate small, produced into two small dorsal protuberances. Ventral seta arising from a narrow, elongate sclerite that lies along the ventral margin of the lateral sclerite. Anal claw with 2 ventral teeth, posterior tooth larger than anterior tooth.

***R. nevadensis* Banks, 1914**

Male.—In lateral view (Fig. 2) most of anal sclerite enclosed by Xth tergite, only the tip exposed. Phallic apparatus with lateral processes fused into a tube which surrounds the phallus and appears attached to it ventrally.

Female.—VIIIth segment a truncate cone (Fig. 5a) similar to *vaefes*; in lateral view posterior margin slightly concave, postero-ventral angle produced. Vaginal apparatus (Fig. 5b) lightly sclerotized; lateral pieces with apices narrowly rounded, mesal margins straight.

Larva.—Same as *R. vaefes*.

***R. jewetti* Denning, 1954**

Male.—Most of genitalia (Fig. 3) similar to *R. vaefes*. Anal sclerite very similar to *R. vaefes*, in dorsal view anal sclerite not expanded at apex. Phallic apparatus

with lateral, dorsal, and ventral processes; dorsal process furcate at apex (Fig. 3c); ventral process bearing a large spine on either side subapically.

Female.—VIIIth segment (Fig. 6a) more or less a truncate cone as in *R. vaefes* and *R. nevadensis*; in lateral view posterior margin with a sinuate emargination, postero-ventral angle acute; in dorsal view posterior margin with a deep, narrow emargination (Fig. 6c). Vaginal apparatus (Fig. 6b) elongate, posterior quarter sclerotized remainder membranous; lateral pieces with apices pointed, mesal margins nearly straight.

Larva.—Same as *R. vaefes*.

ACKNOWLEDGMENTS

I wish to thank Dr. N. Anderson and Mr. R. Wisseman of Oregon State Univ. for the loan of many specimens. I also appreciate the efforts of Dr. Glenn Wiggins, Royal Ontario Museum, Toronto, and Dr. Ken Manuel, Duke Power Co., for reading the manuscript and making many helpful suggestions. Dr. Fernand Schmid kindly gave permission to reproduce his excellent figures of the male of *R. vaefes* and *R. nevadensis*.

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**The Final-instar Larva of *Venturia townesorum*
(Hymenoptera: Ichneumonidae)¹**

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The *Nigriscapus* Group of the genus *Venturia* (Porizontinae) consists of fifteen New World species, all but one tropical. Only *V. nigriscapus* has had the larva previously figured (Finlayson, 1975; Short, 1978). An adult male of *Venturia townesorum* Wahl (1984a), reared from *Pareuchaetes insulata* (Walker) [Arctiidae] on *Chromolaena odorata* (L.) R. M. King and H. Robison, a tropical composite, was preserved with its larval remains. The host larva was collected by R. E. Crutwell of the Commonwealth Institute of Biological Control at Catemaco, Veracruz, Mexico, 8 July 1969; the adult wasp emerged on 2 Aug. 1969. The parasitoid cocoon was within the host pupa; the cast skin of the final-instar larva was extracted, and is here described and illustrated.

The terminology of the cephalic sclerites is that of Finlayson (1975) and Short (1959), except that *length of mandible* is used for "full width of mandible." Methods of preparation differ from those of Beirne (1941); they consist of: 1) soaking the larval remains for 24 hours in water, 2) briefly ultrasonicing the larval skin, and 3) clearing the cephalic sclerites in Nesbitt's solution. A more detailed discussion of these methods is given by Wahl (1984b).

DESCRIPTION

Cephalic sclerites (Fig. 1) well sclerotized. Epistoma absent; pleurostoma lightly sclerotized and mesal end with dorsal recurved process; superior mandibular process long and broad; inferior mandibular process with posterior strut not visible; hypostoma terminating in long dorsal extension; hypostomal spur about $0.9\times$ as long as basal width. Stipital sclerite about $0.7\times$ as long as hypostoma, broad and of uniform width except for median constriction; median V-shaped carina present. Labial sclerite about $1.2\times$ as long as wide; ventral portion about $0.2\times$ as long as length of sclerite; interior ventral margin medially emarginate, width of ventral portion about $3.0\times$ median width of lateral arm; medial face of lateral arm not serrated; ventral part with small, weakly sclerotized lateral areas present. Prelabial sclerite Y-shaped; free ventrally, touching labial sclerite dorsally; stem about $0.8\times$ as long as arm. Silk press weakly sclerotized. Mandible with short, slightly curved, strongly sclerotized blade, its length about $0.4\times$ as long as mandible. (Antenna not on slide, but was circular and lightly sclerotized.) Skin covered with small, bubble-like protuberances and with very few small setae.

The adult and the slides of the cephalic sclerites and skin were deposited at the National Museum of Natural History, Washington, D.C.

¹ Contribution no. 1916 from the Department of Entomology, University of Kansas, Lawrence, Kansas 66045.

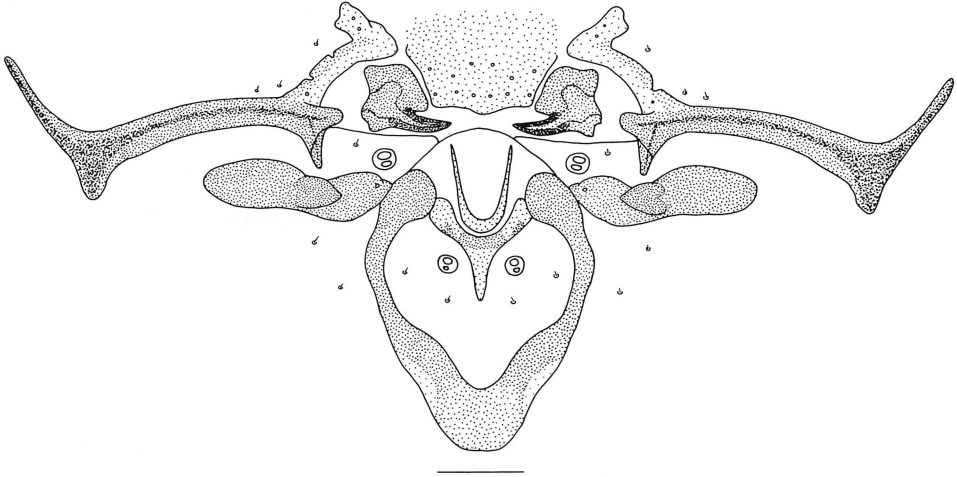


Figure 1. Cephalic sclerites of *Venturia townesorum*. (Scale line = 0.1 mm.)

DISCUSSION

The only key to *Venturia* larvae is that of Finlayson (1975), which deals with seven Nearctic species, five of them undescribed. I have examined the adults with which Finlayson's larval skins were associated. Her *Venturia* sp. F is a species of *Sinophorus*, and *Venturia* sp. D is *V. nigriscapus* (Viereck), which thus comes out twice in the key.

Since sp. F belongs to *Sinophorus*, the condition of the prelabial stem being longer than the prelabial arm can be used as a recognition character of *Sinophorus*; *Venturia* has the stem as long as the arm. The polarity of this character is unknown at this time.

Since *V. nigriscapus* comes out twice in Finlayson's key, the relation of length to width of the hypostomal spur must be used with caution as a taxonomic character; it appears to vary within *nigriscapus*.

In searching for characters that would distinguish the known larvae of the *Nigriscapus* Group (*nigriscapus* and *townesorum*), other species of *Venturia* and the genera *Campoplex* and *Sinophorus* were used as outgroups for determining character polarity. One possible synapomorphy for the group is the long dorsal extension of the hypostoma. Finlayson's *Venturia* sp. C possesses a similar feature, but its length and angle relative to the hypostoma differ from those of *nigriscapus* and *townesorum*. Another synapomorphy might be the medially emarginate interior ventral margin of the labial sclerite, which is more developed in *townesorum*. Although several *Sinophorus* species also possess a similar character, it is probably a parallelism, based upon congruence with other characters.

V. townesorum differs from *nigriscapus* by the long and broad superior mandibular process, the V-shaped carina of the stipital sclerite, and the lack of serrations on the medial face of the lateral arm of the labial sclerite.

There are eleven described and approximately forty undescribed Nearctic species of *Venturia*. Of these, the larvae of nine are known, including three new ones to be described later. The chances that a specimen will belong to an unfigured species

are high enough that I do not envision a rewritten key as serving any useful purpose.

ACKNOWLEDGMENTS

I am grateful to T. Finlayson, Department of Biological Sciences, Simon Fraser University, and C. D. Michener, Department of Entomology, University of Kansas, for their comments and suggestions. I wish to thank A. S. Menke, National Museum of Natural History, Washington, D.C., and J. R. Barron, Canadian National Collection, Ottawa, for loaning specimens for this study.

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**Extensions of Range for Some Seashore and Intertidal
Beetles of Western North America
(Coleoptera: Staphylinidae, Carabidae,
Malachiidae & Rhizophagidae)**

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Abstract.—Geographical range extensions and biological notes are presented for the seashore and intertidal Coleoptera: Staphylinidae—*Cafius lithocarinus* LeConte, *C. luteipennis* Horn, *C. opacus* LeConte, *Hadrotus crassus* LeConte, *Diaulota harteri* Moore, *D. vandykei* Moore, *Briothinusa catalinae* Casey, *Salinamexus giuliani* Moore, *Aleochara arenaria* Casey; Malachiidae—*Endeodes blaisdelli* Moore; Carabidae—*Thalassotrechus barbarae* (Horn); Rhizophagidae—*Phyconomus marinus* (LeConte).

The marine insect fauna of the Pacific Coast of North America is a distinctive and interesting assemblage. Recent reviews of the coleopteran elements of this fauna (Moore and Legner *in* Cheng, 1976) have suggested that species may be 1) widespread, with geographic ranges extending from Alaska to Baja California or 2) limited, with range extremes at Point Conception, California and/or Monterey Bay, California. These patterns of distribution are shown by the "wide ranging" species *Cafius luteipennis* LeConte, *C. lithocarinus* LeConte and *Hadrotus crassus* LeConte and the "limited ranging" species (south of Point Conception) *Diaulota harteri* Moore, *Briothinusa catalinae* Casey, *Cafius opacus* LeConte and *Endeodes blaisdelli* Moore. A northern extension of the range of the "limited range" species *Diaulota vandykei* Moore to Bear Harbor, Mendocino Co., California, some 300 miles north and across the Monterey Bay area, seemingly challenges the theory that Monterey Bay has been a barrier area, although it is possible that *D. vandykei* is a "wide ranging" species that has not been collected throughout its full range.

Additional collections from the rarely collected intertidal habitat are necessary to determine if there are areas along the coast that have acted as barriers to the distributional movement of intertidal Coleoptera.

NEW RECORDS

Staphylinidae

1. *Cafius lithocarinus* LeConte. Previously reported from British Columbia to the north end of Cedros Island, Baja California Norte, Mexico. New record, 61

¹ Deceased.

specimens, Tortugas Bay, Baja California Sur, Mexico, III-18-1981, migratory flight moving north, F. Andrews and D. Faulkner.

These specimens were collected as a part of a northward moving migratory flight (see Leech and Moore, 1971). This flight was over a broad sandy beach littered with numerous partially buried clumps of washed up kelp. The flight began about 9 AM when there were very few individuals in the air. The insects continually increased in numbers until approximately 11 AM when 10 to 12 random sweeps of an insect net would capture several hundred specimens. After this the flight rapidly diminished and by 12 noon was completed. The individuals were moving in a northerly direction with thousands being in the air at one moment followed by periods when only dozens were in the air.

2. *Cafius luteipennis* Horn. Previously reported from British Columbia to El Tomatal (near Miller's Landing), Baja California Norte, Mexico (Orth and Moore, 1980). New record, 1 specimen, Tortugas Bay, Baja California Sur, Mexico, III-18-1980, under kelp on rocky beach, F. Andrews and D. Faulkner.

3. *Cafius opacus* LeConte. Previously reported from Refugio State Beach, Santa Barbara Co., California to Socorro Dunes, Baja California Norte (Orth and Moore, 1980). New record, 1 specimen, 13.0 mi N El Rosario, Baja California Norte, Mexico, III-15-1981, under kelp on rocky beach, F. Andrews and D. Faulkner.

4. *Hadrotus crassus* LeConte. Previously reported from Alaska to Baja California (Moore and Legner, 1976). This is based on specimens collected by Ian Moore at Descanso Bay, Baja California Norte, Mexico. New record, 1 specimen, Tortugas Bay, Baja California Sur, Mexico, III-18-1981, under kelp on rocky beach, F. Andrews and D. Faulkner.

5. *Diaulota harteri* Moore. Previously reported from La Jolla Shores, San Diego Co., California to Descanso Bay, Baja California Norte, Mexico (Moore, 1956). New record, 2 specimens, Cedros Island, North Point, Baja California Norte, Mexico, III-20/21-1981, intertidal rock crevices, F. Andrews and D. Faulkner. This extends the known range about 300 miles south.

6. *Diaulota vandykei* Moore. Previously reported from Shell Beach, San Luis Obispo Co., California to Pacific Grove, Monterey Co., California. New record, 10 specimens, 1 mi NW New Albion, X-24-1980, intertidal rocks, D. Giuliani.

7. *Bryothinusa catalinae* Casey. Previously reported from White Point, Los Angeles Co., California (Moore and Orth, 1978) to La Jolla, San Diego Co., California (Moore, 1956). New record, 4 specimens, Cedros Island, North Point, Baja California Norte, Mexico, III-20/21-1981, intertidal rock crevices, F. Andrews and D. Faulkner. This extends the known range about 350 miles south.

8. *Salinamexus giulianii* Moore. Previously reported from La Push, Callum Co., Washington (Moore, 1978). New record, 10 specimens, Bear Harbor, Mendocino Co., California, X-26-1980, F. Andrews and D. Giuliani.

9. *Aleochara arenaria* Casey. Previously reported from British Columbia to Baja California, Mexico (no locality given, Moore and Legner, 1977). New record, 7 specimens, Tortugas Bay, Baja California Sur, Mexico, III-18-1981, under kelp on rocky beach, F. Andrews and D. Faulkner.

Malachiidae

10. *Endeodes blaisdelli* Moore. Previously known from Colonia Guerrero, Baja California Norte, Mexico (Moore, 1954) to 39 mi N Guerrero Negro at Miller's

Landing, Baja California Norte, Mexico (Moore and Mayor, 1976). New record, 23 specimens, Tortugas Bay, Baja California Sur, Mexico, III-18-1981, under kelp on rocky beach, F. Andrews and D. Faulkner.

Carabidae

11. *Thalassotrechus barbarae* (Horn). Known geographic distribution from Humboldt Co., California to Bahia Magdalena, Baja California Sur. New record, 36 specimens, north end Cedros Island, Baja California Norte, III-20/21-1981, intertidal rock crevices, F. Andrews and D. Faulkner. This locality is intermediate to the known California and Baja California Sur collections. Morphologically these specimens fit the curves presented by Evans (1977), with an average body length of 26.2 ± 1.4 mm. All individuals are testaceous with pigment spots.

Rhizophagidae

12. *Phyconomus marinus* (LeConte). Known geographic distribution central California south to San Diego Co., California. New record, 9 specimens, 10 mi N El Rosario, Baja California Norte, Mexico, VII-3-1979, on kelp on rocky beach, D. Giuliani.

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The First Record of a Tachinid Fly as an Internal Parasitoid of a Spider (Diptera: Tachinidae; Araneae: Antrodiaetidae)

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Flies of the family Tachinidae are internal parasitoids on a wide variety of hosts (Arnaud, 1978). This however, is the first report of a spider, *Atypoides riversi* O. P.-Cambridge (Antrodiaetidae) serving as a tachinid host (Rollard, 1984; Arnaud and Schlinger, pers. comm.). *Atypoides riversi*, a fossorial mygalomorph commonly found in the Coast and Sierra Nevada Ranges of California (Coyle, 1968) is also a host for several pathogens, parasitoids, and parasites (Vincent, in press), including the only other taxa reported to be internal parasitoids of spiders—acrocerids and nematodes.

Two tachinid larvae emerged in the laboratory, each from the abdomen of a large immature *A. riversi*, from a total of 74 spiders that were collected along a stream bank within the University of California's Blodgett Forest Research Station on 12 August 1982. These larvae were clearly visible in their hosts and emerged and pupated within a day after emergence and developed within their puparia to teneral adult females. Unfortunately, neither adult emerged, but they were removed from their pupal cases in 1984 and identified as an undescribed species of *Lypha* by D. M. Wood. The known hosts of North American *Lypha* are immature stages of Lepidoptera of the families Gelechiidae, Olethreutidae, and Tortricidae.

Perhaps the laboratory conditions were not appropriate for the tachinids to complete development. I suspect, however, that the two spiders may have been accidental hosts since only two tachinids emerged from over 345 *A. riversi* of all ages collected at Blodgett, examined for signs of parasitoids, and reared in the laboratory for various periods of time since 1975.

ACKNOWLEDGMENTS

I thank Dr. E. I. Schlinger, Dr. C. E. Griswold, and Mr. D. Glaser, University of California, Berkeley, for help in the field, Dr. D. M. Wood, Biosystematics Research Institute, Ottawa, Canada, for identifying the tachinids, and Dr. Schlinger for helpful criticism of this report. I also thank Mr. Robert Heald, Forest Manager, Blodgett Forest Research Station, University of California for his cooperation. A Georgia Southern College Foundation Fellowship funded this project.

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Announcement

The *Tribolium* Information Bulletin is an informal newsletter which includes research, technical and teaching notes on *Tribolium* and other Coleoptera; lists of wild type and mutant stocks available in different laboratories throughout the world; a current bibliography; and a personal and geographical directory of researchers using flour beetles in their research. The 25th volume of this newsletter will be published in 1985.

Owing to the fact that Cal State University, San Bernardino has outgrown its available space, we can no longer store the earlier issues of this newsletter. We are therefore, making them available at \$5/volume plus postage and handling on a first-come, first-served basis until they are gone.

Contact the editor: Alexander Sokoloff, Department of Biology, California State University, San Bernardino, California 92407.

Scientific Note

A New Record for *Philanthus neomexicanus* Strandtmann (Hymenoptera: Philanthidae) and Some Insects Found in Its Burrow

On August 31, 1982, I observed an adult female of *Philanthus neomexicanus* Strandtmann (Hymenoptera: Philanthidae) flying with prey over sand dunes at Beach North, Point Reyes, California. After landing, the wasp uncovered a hole in the sand, entered with the prey, plugged the hole from the inside and stayed for several minutes. I captured her as she emerged. Guided by an inserted buckwheat stem, I excavated the oblique tunnel to reveal a pile of insect cadavers approximately 12 cm into the tunnel at a vertical depth of approximately 8 cm. No side tunnel branches or chambers were uncovered, nor were any wasp immatures found.

The insect bodies in the tunnel were mostly intact and in good enough condition to allow identification. There were three males and one female of *Lasioglossum pavonotum* (Cockerell) (Hymenoptera: Halictidae) and a male of *Sphaerophoria cylindrica* (Say) (Diptera: Syrphidae).

Although this record is outside the previously known geographical and temporal limits of *P. neomexicanus* (Bohart and Grissell, 1975, Bull. Calif. Ins. Surv., 19: 1-92), less is known of its biology than of other *Philanthus* species. Nonetheless, the presence of a fly among the insects piled in the burrow is unusual. In field studies of *Philanthus* wasps and their nests, it is standard to assume that paralyzed insects found in tunnels or brood cells have been provisioned by the attending female (Powell and Chemsak, 1959, J. Kans. Entomol. Soc., 32:115-120; Evans, 1966, Great Basin Nat., 26:35-40). Bees are the most common prey of this genus, but members of other hymenopteran families including Ichneumonidae, Chrysididae, Sphecidae, Vespidae and Scelionidae are occasional prey (Evans, 1970, Bull. Mus. Comp. Zool., 140:451-511). So, if the syrphid in the burrow were prey, a broad taxonomic gap in prey selection has been bridged. However, there is a superficial resemblance between *S. cylindrica* and the bees preyed upon by *P. neomexicanus* in size and banding pattern. The female wasp may have used visual cues for prey selection and captured the fly in error. Indeed, Evans and Lin (1959, Wasmann J. Biol., 17:115-132) attribute *Philanthus*' capture of certain wasps to the bee-like qualities of the latter.

The fly's presence in the tunnel does not confirm that it is suitable prey. The nest lacked brood cells, and the fly and paralyzed bees were piled in the main tunnel. These indicate that the nest was in an early stage of development. Presumably the female could still reject the fly during later stages of nest construction, or it could be refused by her larval offspring. Thus, while the observation may be indicative of a previously unknown prey resource of *P. neomexicanus*, such cannot be substantiated by this observation.

For species determinations I am grateful to H. V. Daly (bee), R. M. Bohart (wasp) and E. I. Schlinger (fly).

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On the Biology of *Acanthochalcis nigricans* Cameron and *Acanthochalcis unispinosa* Girault (Hymenoptera: Chalcididae)

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Abstract.—The biological information for the genus *Acanthochalcis* Cameron is reviewed. Rearing and habitat information is presented, recording the emergence from beetle infested wood of *A. nigricans* Cameron from interior live oak (*Quercus Wislizenii* A. DC.) and of *A. unispinosa* Girault from valley oak (*Quercus lobata* Nee). The probable hosts proposed for both species of *Acanthochalcis* are beetles in the family Buprestidae (Coleoptera).

The two *Acanthochalcis* Cameron are the largest members of the family Chalcididae in North America. The recorded range is: *A. nigricans* Cameron—Kansas, Oklahoma, Texas, New Mexico, Arizona, California and Mexico; *A. unispinosa* Girault—Texas, Arizona and California (Burks, 1979). Prior to this paper, host information was virtually nonexistent; being restricted to a statement by Alexandra A. Girault (1920) of a small female *A. nigricans* which was reared from a flat-headed apple borer in Phoenix, Arizona, 21 September 1915, by A. W. Morrill. This host has been interpreted as *Chrysobothris femorata* (Olivier) (Coleoptera: Buprestidae) (Peck, 1963). Adults of *C. femorata* measure about 8 mm in length. This apparent host record was not listed in Burks (1979).

A. nigricans females have been measured that range in length from 7 to 24 mm, but are usually about 20 mm. Males range in length from 8 to 11 mm, but are usually about 10 mm. *A. unispinosa* females have been measured that range in length from 17 to 27 mm, but are usually about 21 mm. Males range from 5 to 11 mm, but are usually about 10 mm. Males and females are not as drastically dimorphic in body size as inferred by the body length measurements, because about one-half of the female length is attributed to the posteriorly projecting ovipositor sheath. While it is possible that *Acanthochalcis* could successfully develop within the larva of *C. femorata*, metamorphosing into a very small adult, the more common large sized adults would indicate a host larva substantially larger.

Recently, a single male specimen of *A. nigricans* (11 mm) was reared from interior live oak (*Quercus Wislizenii* A. DC.) wood cut on 10 January 1983, from a steep rocky hillside of Little Table Mountain (Valley Grassland/Foothill Woodland Ecotone), Madera County, California. The wood, cut into 18 pieces, 22 to 48 cm in length and 5 to 10 cm in diameter, was held outdoors in a sealed cardboard box and checked periodically for insect emergence. Adults of *Dicerca horni* Crotch (Coleoptera: Buprestidae) and larvae of *Dicerca* sp. were collected

when the wood was cut. On 31 August 1983, the chalcidid was found dead in the box after having emerged from the most heavily cracked and scarred area of a 10 cm diameter trunk. The round emergence hole was 2 mm in diameter and extended through 8 mm of wood and 3 mm of bark. Excavation of the emergence burrow to obtain the chalcidid's larval and pupal exuvia, and to locate host remains, was unsuccessful. Other insects reared from this lot of wood were *Dicerca horni*, *Polycesta californica* LeConte (Coleoptera: Buprestidae) and *Prionoxystus robiniae* (Peck) (Lepidoptera: Cossidae). Of these, the probable hosts are *D. horni* and/or *P. californica*.

Rearing of valley oak (*Quercus lobata* Nee) from Mooney Grove (Foothill Woodland—a remnant stand of the valley floor oak parkland), Visalia, Tulare County, California, produced both a male (10 mm) and female (18 mm) *A. unispinosa* which emerged on 15 and 29 April 1982 respectively. Several 5 to 8 cm diameter limbs, which had fallen from a height of 5 to 7 m, were collected in late March 1982 and kept indoors in metal trash cans and checked daily. The only buprestid reared from this wood was *P. californica*, five specimens of which emerged between 21 April and 24 May 1982. Although doubtful as hosts, *Phymatodes lecontei* Linsley, *Xylotrechus nauticus* (Mannerheim) and *Neoclytus modestus* Fall (all Coleoptera: Cerambycidae) were also reared from this lot of wood.

While this biological information supports Girault's statement suggesting a probable host, the question remains whether the *Acanthochalcis* were reared from the buprestid beetles or just associated with them, in that these insects emerged from the same piece or lot of wood.

ACKNOWLEDGMENTS

We wish to thank Dr. Richard Westcott, Oregon State Department of Agriculture, Salem, Oregon, for determining the Buprestidae. We are very grateful to Dr. Donald Burdick, California State University, Fresno, for his comments on the manuscript.

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Scientific Note

Diet of Larval *Dytiscus dauricus* (Coleoptera: Dytiscidae) in East-central Arizona

It is well known that *Dytiscus* larvae are voracious predators, however, dietary information on natural populations is lacking for some members of the genus. Larval *Dytiscus* are cannibalistic but also prey on a variety of larval and adult macroinvertebrates (Leech and Chandler, 1956, Aquatic Coleoptera, pp. 293–371 in Usinger's Aquatic insects of California with keys to North American genera and California species, Univ. California Press, Berkeley and Los Angeles), larval amphibians (Formanowicz and Brodie, 1982, Copeia, 1982:91–97), and even small fish (Balfour-Brown, 1950, British water beetles, Vol. 2, Bartholomew Press, London, 394 pp.) and garter snakes (Drummond and Wolfe, 1981, Coleop. Bull., 35:121–124). I report feeding observations of final instars of *D. dauricus* from east-central Arizona.

I observed a total of 15 feeding larvae from 21 June–27 August 1983, at Big Meadows Tank (BMT) 1; a permanent pond 1.0 km NNW of the western edge of Sunrise Lake, Apache Co. (elev. 2775 m). Number and kind of prey taken were 5 *D. dauricus* larvae, 4 *Limnephilus* sp. (caddisfly) larvae, 3 odonate larvae, 2 *Ambystoma tigrinum* (salamander) larvae, and 1 corixid adult. Four observations of cannibalism were witnessed between 21 June–6 July and 1 on 25 July. Cannibalism appears to be more prevalent in late spring and early summer when larvae are more abundant. *Limnephilus* sp. is very abundant in July and August at BMT 1 and may be a major food item of *D. dauricus* larvae. Interestingly, 2 of the 4 captured caddisfly larvae were without case. Beetle larvae may occasionally extract caddisflies from their case just prior to or after killing them. I was not certain if the captured caddisflies with case were killed. Two of the 3 odonates taken in mid-July were coenagrionids which were abundant in BMT 1 at this time. Observations of beetles feeding on larval *A. tigrinum* were on 12 and 13 July. Salamanders were about 35–40 mm from tip of snout to posterior end of vent. The overall impact of *D. dauricus* larvae on this population of salamanders is unclear, however, other studies indicate larval *Dytiscus* may have an important effect on amphibian densities (Formanowicz, 1982, J. Anim. Ecol., 51:757–767; Kruse, 1983, Oecologia, 58:383–388).

In conclusion, *D. dauricus* final instars appear to be opportunistic feeders. Mature larvae are apparently a top predator in some of the fishless, montane ponds of east-central Arizona, and accordingly, may have an important impact in structuring these communities.

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**New Species of *Eleodes* from California and Nevada
(Coleoptera: Tenebrionidae)**

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Fieldwork during the last 10 years in California and adjacent parts of Nevada has led to the recognition of the two species described here.

***Eleodes (Metablapylis) insolitus*, NEW SPECIES**

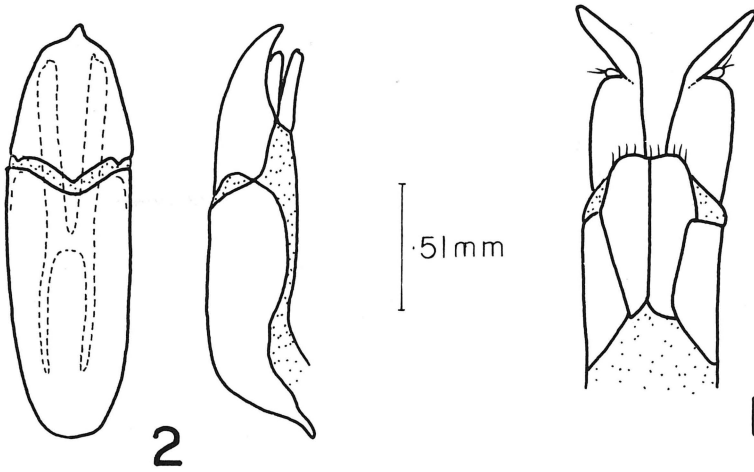
Elongate ovate to slender black beetles with the sutural edge of the elytra raised as a slight carina.

Female.—Head weakly convex between eyes; epistomal canthus slightly raised over antennae, less prominent than eyes; epistomal suture finely impressed, complete except for small median area; dorsum of cranium set with tubercles $1-2 \times$ eye facet diameter, separated by about $1-2$ diameters centrally, becoming denser and finer posteriorly, slightly coarser anteriorly, sometimes with small, irregular bare patches centrally; tubercles bearing very short, fine, anteriorly inclined setae. Antennae gradually enlarged to apical segment, reaching slightly beyond pronotal base; segment length ratios approximately as follows: $3.2:1.5:5.5:3.1:2.4:2.4:2.5:2.5:2.5:2.4:2.8$; segments 3–8 elongate, becoming trapezoidal distally; segments 9–10 subglobular; 11 asymmetrically tear drop-shaped. Mentum tuberculate, median lobe bluntly deltoid, much elevated above lateral lobes.

Pronotum $\frac{4}{5}$ as long as wide, widest at about anterior $\frac{1}{3}$; anterior border unmarginated, nearly straight except near slightly produced acute anterior angles; lateral borders finely, obscurely margined, finely denticulate; evenly arcuate nearly to obtuse posterior angles, then very slightly everted; posterior border weakly bisinuate, narrowly margined; pronotal disk uniformly set with tubercles about $1-2.5 \times$ eye facet diameter, sometimes with narrow, bare, shallow median depression; tubercles bearing fine, backwardly inclined setae less than tubercle diameter in length. Hypomeron and prosternum sculptured as disk, but tubercles finer, near lateral carina sparser; setae directed dorsad. Prosternal process about twice as broad behind as between coxae, then attenuate to narrowly rounded, prominent apex.

Elytra elongate oval; widest at middle, disk somewhat flattened, with medial margins raised as carina in anterior $\frac{3}{4}$; set with tubercles about $1-2.5 \times$ eye facet diameter near humeri and along lateral-most contour of elytron; tubercles gradually decreasing to about $0.5 \times$ eye facet diameter near suture and to about $1 \times$ eye facet diameter near epipleural carina. Epipleuron finely tuberculate, slightly narrowed just behind humerus, then subparallel nearly to apex, which is slightly expanded, producing weak caudal process.

Meso- and metasterna with setiferous tubercles about size of eye facets, separated by about $1-2$ tubercle diameters. Abdominal sterna slightly convex in lateral silhouette; first sternite with tubercles about size of eye facets, separated by about



Figures 1, 2. Genitalia of *Eleodes insolitus*. 1. Apex of ovipositor, dorsal. 2. Aedeagus, dorsal and lateral.

2–4 tubercle diameters; tubercles becoming finer on sternites 2–4, obsolescent on sternite 5; attendant setae on sternite 5 about 2–3 times longer than on rest of body.

Femora set with flattened tubercles bearing short, appressed setae; anterior femur with dorsal margin abruptly narrowed just before apex. Tibiae set with short, sharp, semierect spines interspersed with finer, appressed setae; anterior tibia with outer margin keeled in basal half. Tibial spurs and tarsi similar in males and females; protarsus with basal segment produced ventrally with tuft of stiff setae interrupting plantar groove; tarsal claws about as long as basal metatarsal segment.

Ovipositor with coxite produced apically as long, sclerotized, spatulate process with gonostylus set dorsolaterally in notch at about middle (Fig. 1).

Male.—Slightly more slender than female; abdomen nearly flat in lateral silhouette. Aedeagus as in Figure 2.

Measurements.—Elytral length, 7.7–10.6 mm; greatest elytral width, 4.7–6.2 mm; medial pronotal length, 2.8–4.1 mm; greatest pronotal width, 3.2–4.7 mm.

Holotype female (California Academy of Sciences) and 6 ♀ paratypes from Nevada, Esmeralda County, Clayton Valley Sand Dunes, near Silver Peak, IX-17/18-1974, J-T. Doyen. Twelve ♀ and 14 ♂ paratypes, same data, F. G. Andrews and A. R. Hardy. Paratypes in Essig Museum of Entomology, University of California, Berkeley, and California Department of Food and Agriculture Collection, Sacramento.

Eleodes insolitus is superficially similar to *E. dissimilis* Blaisdell, but is distinguished by the tuberculate body (punctate in *dissimilis*) and the medial elytral carina (flat in *dissimilis*). The spatulate process of the coxite is longer than in any other described Eleodini. In this character *insolitus* is similar to *Embaphion* and *Neobaphion*. However, the coxite also bears a spatulate process in *Eleodes dissimilis* (Blaisdell, 1909, pl. 5), though it is shorter than in *Embaphion*. In several other features, such as the shape of the prosternal process and profemur, *insolitus*

resembles members of the subgenus *Metablapylis*, where it is tentatively placed. It differs from *Metablapylis* in its strongly tuberculate body. The spatulate coxites in *E. insolitus* superficially resemble the coxites of many Tentyriinae, and may be an adaptation for depositing eggs beneath the surface of sandy substrates.

It is likely that elongate coxites have been independently derived several times in Eleodini, for example in the subgenera, *Discogenia* and *Metablapylis* of *Eleodes* and again in *Embaphion* and *Neobaphion*. The relationship postulated by Blaisdell between the last two is supported by the presence of relatively large amounts of octanoic acid in their defensive secretions (Tschinkel, 1975). The composition of the secretions of *E. (Discogenia)* and species such as *E. insolitus* may clarify their relationships as well.

Eleodes insolitus is known only from the sand dunes in Clayton Valley, Nevada. A few individuals were taken from the sand surface at night, but most were excavated by Drs. Hardy and Andrews from kangaroo rat (*Dipodomys*) burrows on the flanks of the main dune mass.

Eleodes (Tricheleodes) obesus, NEW SPECIES

(Fig. 3)

Brownish black to black pilose beetles with broadly ovate elytra.

Female.—Head very weakly convex between eyes; epistomal canthus slightly raised over antennae, slightly less prominent than eyes; epistomal suture faintly visible or usually obliterated; dorsum of cranium with small, flattened setigerous tubercles posteriorly, becoming tuberculopunctate or punctate or rugosely punctate anteriorly, tubercles about $1.5 \times$ eye facet diameter; punctures about 1–3 times eye facet diameter; setae black or dark brown, short and appressed posteriorly, becoming much coarser, longer and inclined on epistomum and usually near eyes. Antennae gradually enlarged to apical segment, reaching almost to pronotal base; segment length ratios approximately as follows: 3.0:1.4:5.6:2.9:2.8:2.4:2.4:2.0:2.0:1.8:2.3; segments 3–7 elongate, becoming trapezoidal distally; 8 broadly trapezoidal, 9–10 subglobular, 11 asymmetrically tear drop-shaped. Menthum punctate, median lobe bluntly deltoid, bearing long, coarse black setae laterally; maxillary base, mandibles and labrum all bearing spinose, black setae.

Pronotum about $1.25 \times$ broader than long, widest slightly before middle; anterior border nearly straight with slightly raised margin in lateral thirds; anterior angles slightly obtuse, rounded at apex; lateral borders evenly arcuate or slightly reflexed near posterior angles, irregularly crenulate or occasionally weakly carinate anteriorly, indicated by irregular tubercles or obsolete posteriorly; posterior angles obtuse, obsolete; posterior border nearly straight, finely margined. Disk centrally with very coarse, reticulate punctures, becoming rugosely punctate laterally and then tuberculate near margins; punctures and tubercles bearing short, semierect black setae; hypomeron with setigerous tubercles about $1-2 \times$ eye facet diameter, separated by about 2–3 tubercle diameters; sternum sculpted similarly, but setae much coarser, longer; prosternal process about 1.5 times broader behind than between coxae, then attenuate to a prominent, acutely rounded apex.

Elytra broadly ovate, widest at middle, evenly arcuate in lateral silhouette; disk muricately punctate or tuberculopunctate medially, becoming tuberculopunctate

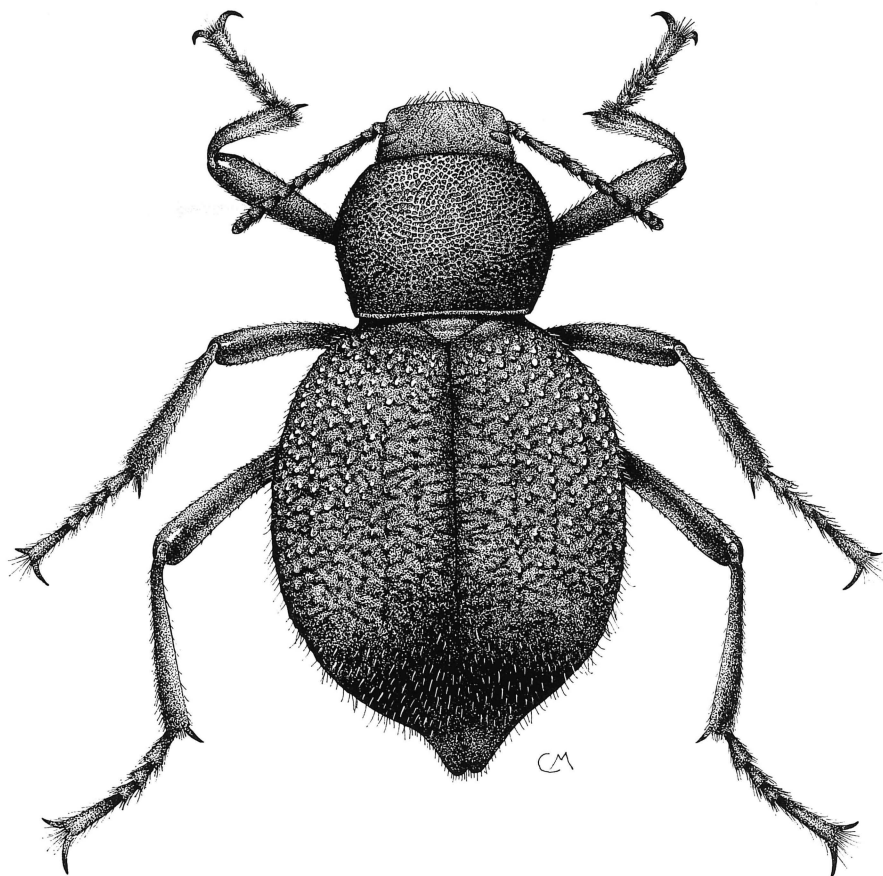
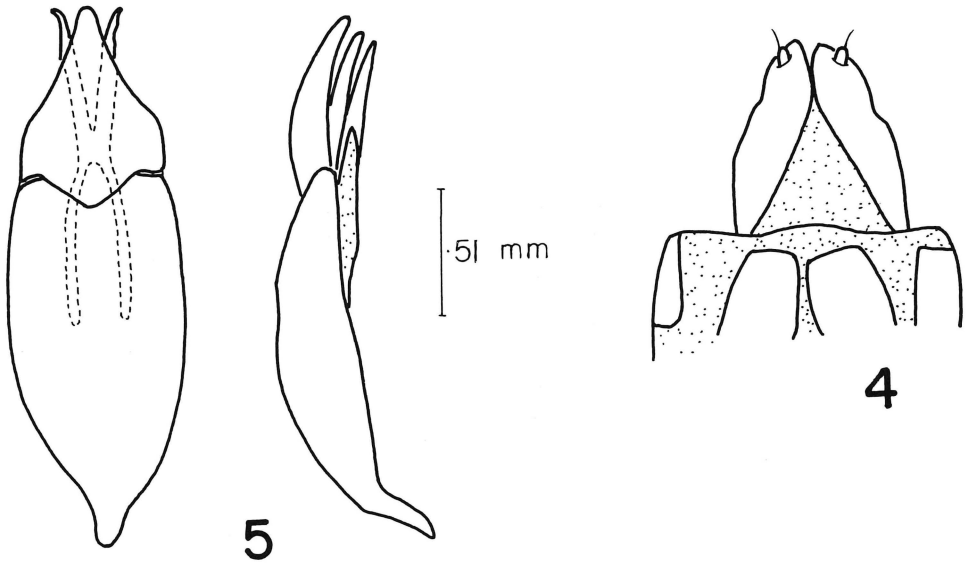


Figure 3. *Eleodes obesus*, female.

or tuberculate laterally; tubercles about $2-5\times$ eye facets in diameter; coarser tubercles forming 8–12 irregular rows, less discernable laterally; large tubercles supertending erect setae about $\frac{3}{4}$ as long as basal metatarsomere; small tubercles with setae $\frac{1}{2}$ that size. Epipleuron finely tuberculate, gradually narrowing almost to apex, then expanded as rounded, ventrally concave caudal process.

Meso- and metasterna and pleura muricately punctate to tuberculate, with short, fine appressed setae laterally, longer, semierect setae medially. Abdominal sterna slightly to moderately convex in lateral silhouette; sparsely muricately, setigerously punctate; setae short to very short, weakly inclined; 5th sternite becoming densely setose along hind margin.

Legs densely muricately and setigerously punctate; femora with setae short, appressed or slightly inclined; tibiae with fine setae on outer surface, mixed with shorter, coarser spines on medial surface; meso- and metatibiae sometimes with few longer, curved setae on posteromedial surface; anterior tibia outwardly keeled in basal $\frac{2}{3}$; meso- and metatibia in basal $\frac{1}{4}-\frac{1}{2}$. Tibial spurs and tarsi similar in sexes; protarsus simple; tarsal claws almost as long as distal protarsomere.



Figures 4, 5. Genitalia of *Eleodes obesus*. 4. Apex of ovipositor, dorsal. 5. Aedeagus, dorsal and lateral.

Ovipositor with coxite weakly sclerotized, setose, with gonostylus set dorso-laterally near apex (Fig. 4).

Male.—Distinctly more slender than female; abdomen flat or slightly convex in lateral silhouette. Aedeagus as in Figure 5.

Measurements.—Elytral length: 9.0–12.4 mm; greatest elytral width, 5.7–8.7 mm; median pronotal length, 2.9–4.1 mm; greatest pronotal width, 3.7–5.5 mm.

Holotype female (California Academy of Sciences) from California, Siskiyou County, Ash Creek Ranger Station, 9 mi E McCloud, 3500', VI-10/12-1974, J. Doyen. Paratypes, same data, J. Chemsak, R. Coville, J. Doyen, D. Green (36 ♀♀, 27 ♂♂); same locality, VI-7/9-1974, J. Sorenson (1 ♀).

Additional material examined.—California, Lassen Co., Pine Creek, IV-21-1949 (1); Modoc Co., nr. Lost Lake, VI-14-34 (2); Shasta Co., Old Station, VI-15-41 (1); Oregon, Klamath Co., V-17-1913 (1).

Eleodes obesus is similar to *E. pilosus* Horn. In *obesus* the elytra are noticeably more inflated and the apices of the epipleura are expanded to produce slight caudae (subparallel to apex in *pilosus*). In *obesus* the pronotal setae are usually short and appressed, the longer elytral setae are about $\frac{3}{4}$ as long as the basal metatarsal segment. In *pilosus* the pronotal setae are erect; both pronotal and elytral setae are about 1–1.5 × as long as the basal metatarsal segment. Specimens from Modoc County have the pronotal setae longer and erect, but have the inflated elytra and caudiform epipleura of *obesus*.

The vegetation at the type locality is coniferous forest on the south slope of Mount Shasta. The substrate is largely volcanic ash, producing the local edaphic aridity which probably allows the beetles to inhabit this region. Other species of *Tricheleodes* occur in more arid parts of the Great Basin to the east.

The individuals comprising the type series appeared suddenly during the second

week of June, suggesting a synchronized emergence. Adults held in rearing containers in the laboratory survived only about 30 days. This indicates a restricted period of adult activity compared to most *Eleodes*, which live many months or up to several years as adults.

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Scientific Note

Mellinus abdominalis Cresson (Hymenoptera: Sphecoidea: Mellinidae)
Discovered in Idaho and Alberta¹

A female *Mellinus abdominalis* Cresson from eastern Idaho was found in the University of Idaho Entomology Collection. The data for this specimen follows: Sand Dunes, St. Anthony (Fremont Co.), ID, 14-IX-1965, A. R. Gittins collector. The pin also bears a label indicating that the specimen was collected from green rabbitbrush, *Chrysothamnus viscidifloris* (Hooker) Nuttall.

The Canadian specimen, a female, was collected by the author while vacationing in Alberta. It was found in the car, thus the exact locality is unknown. The data for this specimen is: near Orion, Alberta, Canada, 27-VIII-1982, J. B. Johnson collector. We had approached Orion from the west on Highway 61.

The specimens were identified using key criteria and descriptions (Siri and Bohart, 1974, Pan-Pac. Ent., 50:169-176). This is the first report of *M. abdominalis* and the family Mellinidae from Idaho and Canada. *Mellinus abdominalis* was previously recorded from Nebraska, Colorado, Wyoming and Montana (Krombein, 1979, in Krombein et al., Cat. Hymen. Am. N. of Mex., Vol. 2, Apocrita, p. 1684).

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The Nymphs, and a New Species, of North American *Setvena* Illies (Plecoptera: Perlodidae)¹

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Stewart and Stark (1984) provided an updated account of nymphs of the 22 North American Perlodinae genera, including the first complete generic key to nymphs and comparative illustrations of the type or other representative species of each genus. That paper provided a complete treatment of nymphs of the 10 monospecific genera, and a useful baseline for the eventual study and analysis of the relatively poorly known nymphs of the remaining 12 genera, representing 43 species.

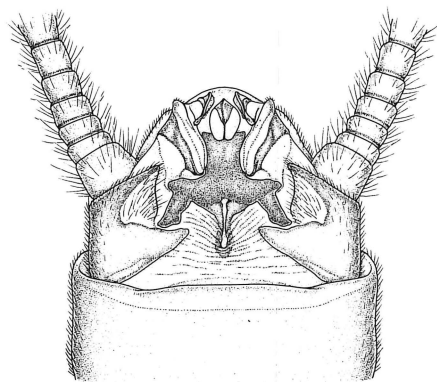
The only comparative studies of nymphs at the species level have been for *Diploperla* (Kondratieff et al., 1981), *Helopicus* (Stark and Ray, 1983), and *Hydroperla* (Ray and Stark, 1981). This study was undertaken to continue efforts to provide comparative descriptions, keys and illustrations for the nymphs of all species in this large and ecologically important subfamily of stoneflies, and specifically for nymphs of the genus *Setvena* Illies.

The genus *Setvena*, previously a subgenus of *Arcynopteryx* (Ricker, 1952) is a distinctive group having simple, finger-like anteroventral gills (nymphs) or gill remnants (adults) on the meso- and metathorax (Ricker, 1952; Shepard and Stewart, 1983; Stewart and Stark, 1984). Two species, *Setvena bradleyi* (Smith) and *Setvena tibialis* (Banks) have been recognized (Smith, 1917; Frison, 1942; Ricker, 1952; Illies, 1966; Stewart and Stark, 1984). The nymphs of *S. tibialis* have never been formally described, illustrated or compared with those of *S. bradleyi*. *S. bradleyi* nymphs were described by Claassen (1931) with illustrations of the labrum, mandibles, maxillae and labium, and by Stewart and Stark (1984) with diagnostic illustrations of the head-pronotum pattern, mandible, maxilla, front leg, mesosternum, thoracic ventrum with gills, male and female abdominal sternae and cerci.

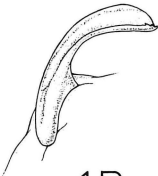
MATERIALS AND METHODS

We began collecting and rearing nymphs of *Setvena* in 1979, as part of a larger study of nymphs of North American Plecoptera genera by K. W. Stewart and B. P. Stark. The large nymphs of this genus live in cool, high mountain streams in the Coast and Cascade Mountains (*S. tibialis*) and northern Rocky Mountains (*S. bradleyi*) (Ricker, 1964) and are difficult to rear outside their native streams. Individuals of both species were reared in styrofoam containers in the field or in living streams at simulated stream temperatures (Stewart and Stark, 1984) or

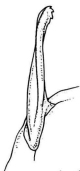
¹ Study supported by National Science Foundation Grants #DEB 78-12565, BSR8308422 and the Faculty Research Fund of North Texas State University.



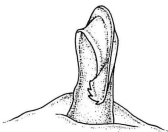
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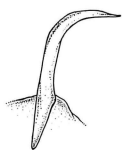
1B



1C



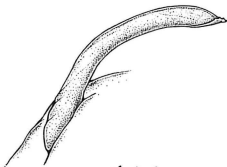
1D



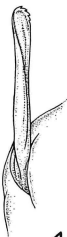
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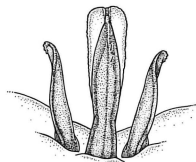
1I



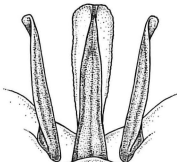
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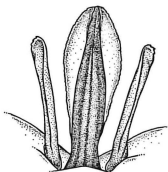
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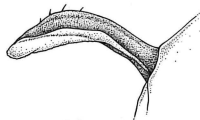
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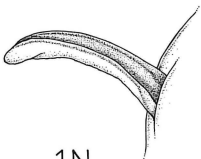
1M



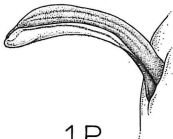
1O



1L



1N



1P

correlated with adults by removing the nymphal cuticle of mature nymphs, after gently heating in 10% KOH to reveal the underlying adult genitalia. Drawings of nymphal characters and adult genitalia were made with aid of a Wild M-5A Stereomicroscope Drawing Attachment, and in some cases Scanning Electron Microscopy.

Setvena wahkeena, NEW SPECIES

Description.—Male: Body length 23–25 mm. Brachypterous, wings 10–11 mm, extending to about 7th abdominal segment. General color brown with yellow markings. Head brown, darker bordering M-line anterior to median ocellus; yellow spot middle of frons; oval yellow spot in ocellar triangle, bordered by dark brown; yellow band from lateral ocelli to interior margin compound eyes; broad yellow band down middle of occipital area, extending transversely to near lateral margins of head; reticulate pattern medial to compound eyes faintly visible; antennae brown. Prothorax narrower than head and wider anteriorly; anterior angles acute, posterior angles rounded; color brown with broad, yellow medial stripe, wider posteriorly and with rounded, yellow rugosities either side. Legs yellow-brown; femora brown distally; tibiae brown proximally and distally; tarsi yellow-brown. Abdomen yellow-brown dorsally with dark band across anterior margin of segments; tergum 10 with complete medial cleft, and produced anteriomedially as narrow processes (Fig. 1A); epiproct narrow, apex membranous on either side of midline, darkly sclerotized at base and along dorsal and ventral surface (Fig. 1A); lateral stylets stout, and curved from lateral view (Fig. 1B), narrow in dorsal view, with high rounded crest and apex produced laterally at tip as 3–4 small teeth (Fig. 1C, D, K).

Female: Unknown.

Nymph: Body color dark brown with brown clothing hairs. Head with small yellow triangles lateral to each lateral ocellus and small yellow oval spots anterior to each lateral ocellus; pair narrow transverse light bars anterior to light M-line on frons; occipital spinule row mostly 1–2 spinules wide, curving forward and meeting at stem of ecdysial line (Fig. 2A). Anterior surface forelegs with short, blunt spinules and few scattered medium length spinules (Fig. 2B). Posterior spinule fringe of first 5 abdominal tergae very short, blunt, slightly longer on last 5 segments (Fig. 2C), mostly equal in length on Ab₉ (Fig. 2D); intercalary spinules very short (Fig. 2C, D).

Types.—Holotype ♂ from small stream ca. 0.5 mi west of mile 18 on Bridal Veil Scenic Rd, 1.5 mi west of Wahkeena Falls, Multnomah Co., Oregon, 1-IV-1983, K. W. Stewart; deposited in USNM. Paratype ♂ from Oregon, Multnomah Co., Wahkeena Falls, 30-VI-1957, S. G. Jewett, Jr. (NTSU).

Etymology.—This species is named after the Wahkeena Falls area where it is found.

←

Figure 1. Adult male characters of *Setvena*. *S. wahkeena*: A, terminalia (dorsal); B, C, D, lateral, dorsal and oblique anterior views of right lateral stylet; K, L, dorsal and lateral views of epiproct. *S. bradleyi*: E, F, G, lateral, dorsal and oblique lateral views of right lateral stylet; M, N, dorsal and lateral views of epiproct. *S. tibialis*: H, I, J, lateral, dorsal and oblique lateral views of right lateral stylet; O, P, dorsal and lateral views of epiproct.

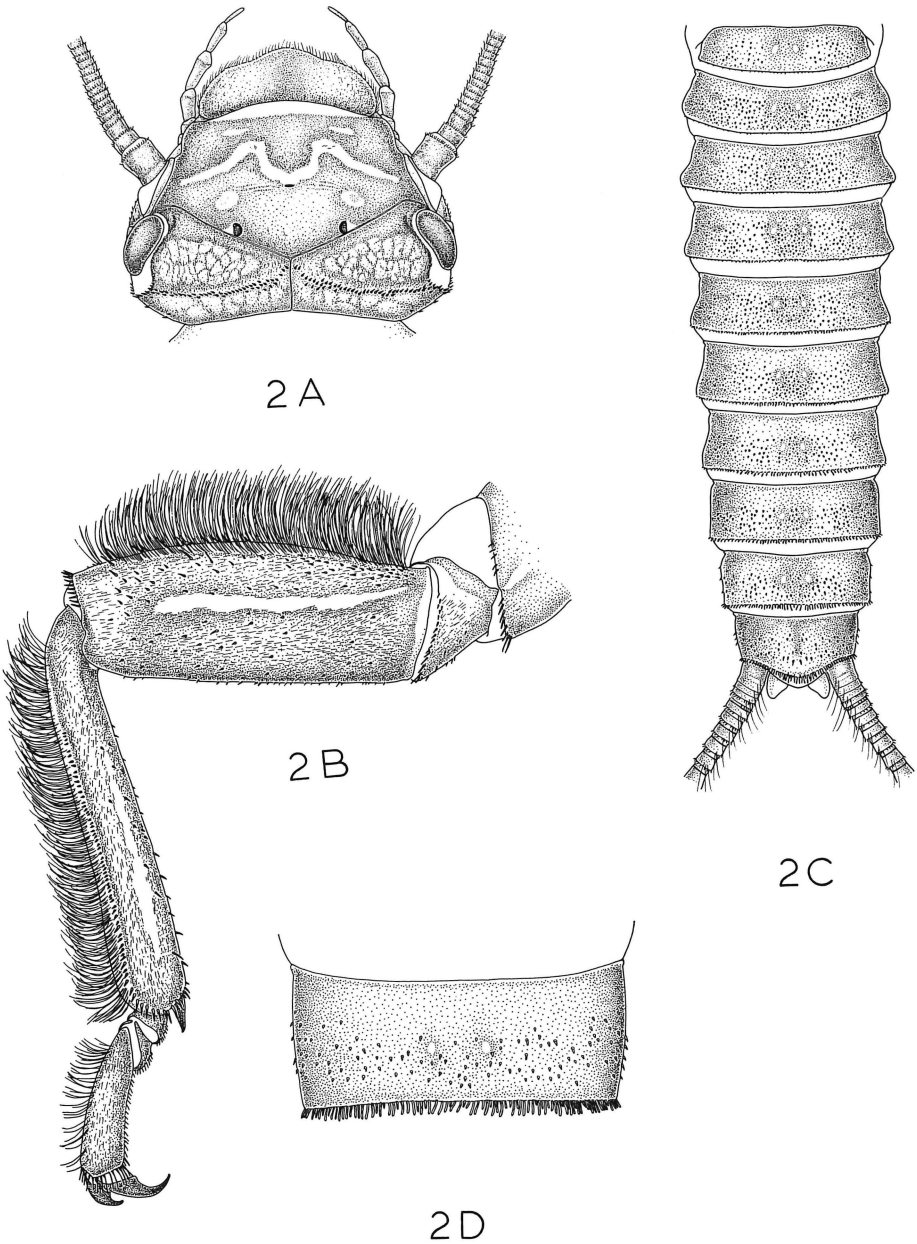


Figure 2. Nymphal characters of *Setvena wahkeena*: A, dorsum head; B, right front leg (anterior); C, dorsum abdomen; D, dorsum Ab₆.

Diagnosis.—Lateral stylets of male *S. wahkeena* are strongly, evenly curved and stout in lateral view (Fig. 1B). Dorsally they have a high, narrow crest (Fig. 1C, D), and their rounded tips bear 3–4 small sharp teeth (Fig. 1C, D, K). The lateral stylets of *S. bradleyi* males are narrow, falcate in lateral view (Fig. 1E) and have a low dorsal crest (Fig. 1F, G, M). Lateral stylets of *S. tibialis* are less strongly curved than the other 2 species (Fig. 1H) with a very low dorsal crest and 4 small

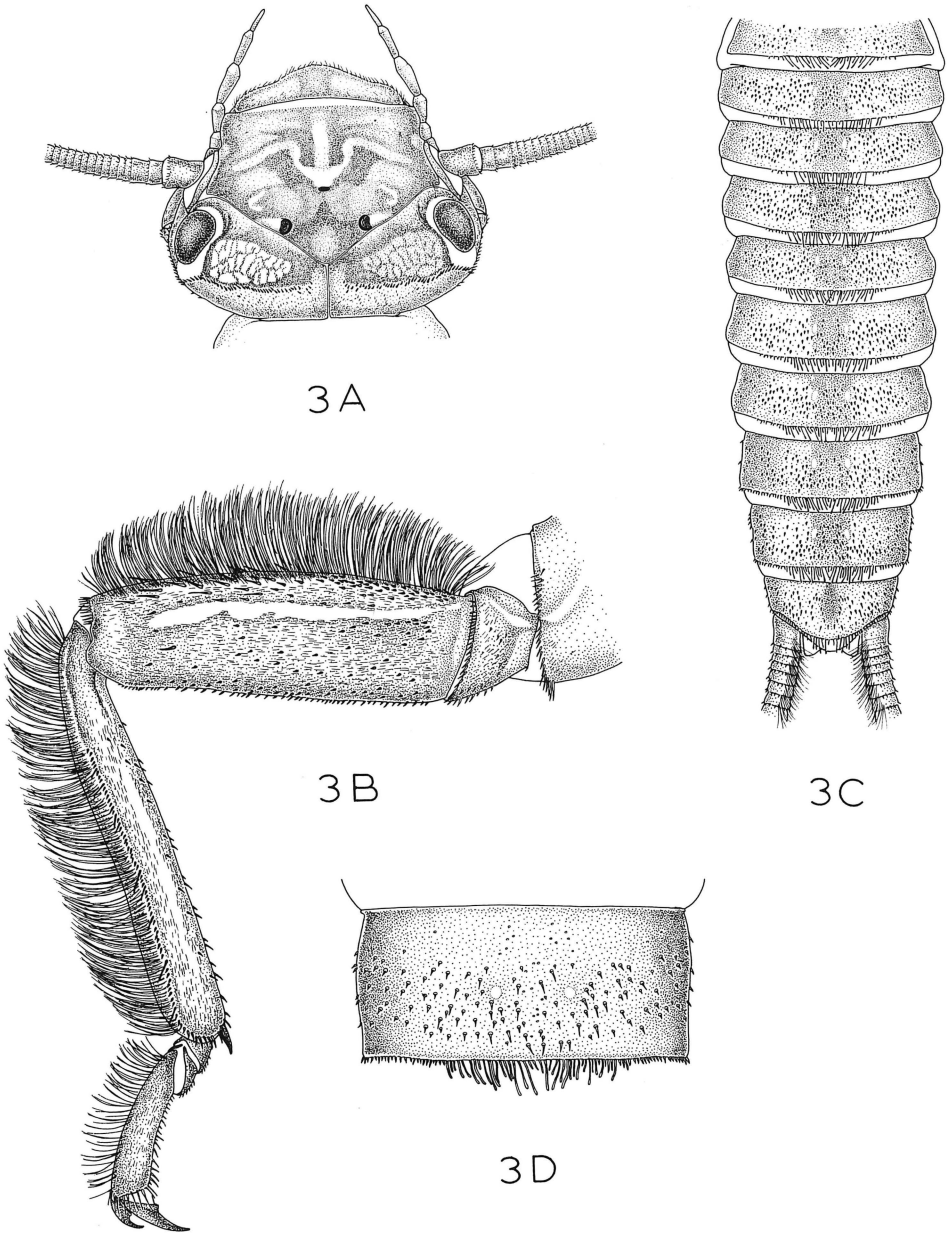


Figure 3. Nymphal characters of *Setvena bradleyi*: A, dorsum head; B, right front leg (anterior); C, dorsum abdomen; D, dorsum Ab₇.

teeth on a rounded tip (Fig. 1I, J, O). The dorsal sclerotized portion of the *S. wahkeena* epiproct: (1) is more robust (Fig. 1K, L) than that of *S. bradleyi*, (2) its sides are more evenly curved and convex in dorsal view (Fig. 1K) than *S. tibialis* (Fig. 1O), and (3) its dorsal carina bears 2–4 short, stout hairs (Fig. 1K, L), unlike *S. bradleyi* or *S. tibialis*.

Nymphs of *S. wahkeenah* can be distinguished from the other 2 species by the

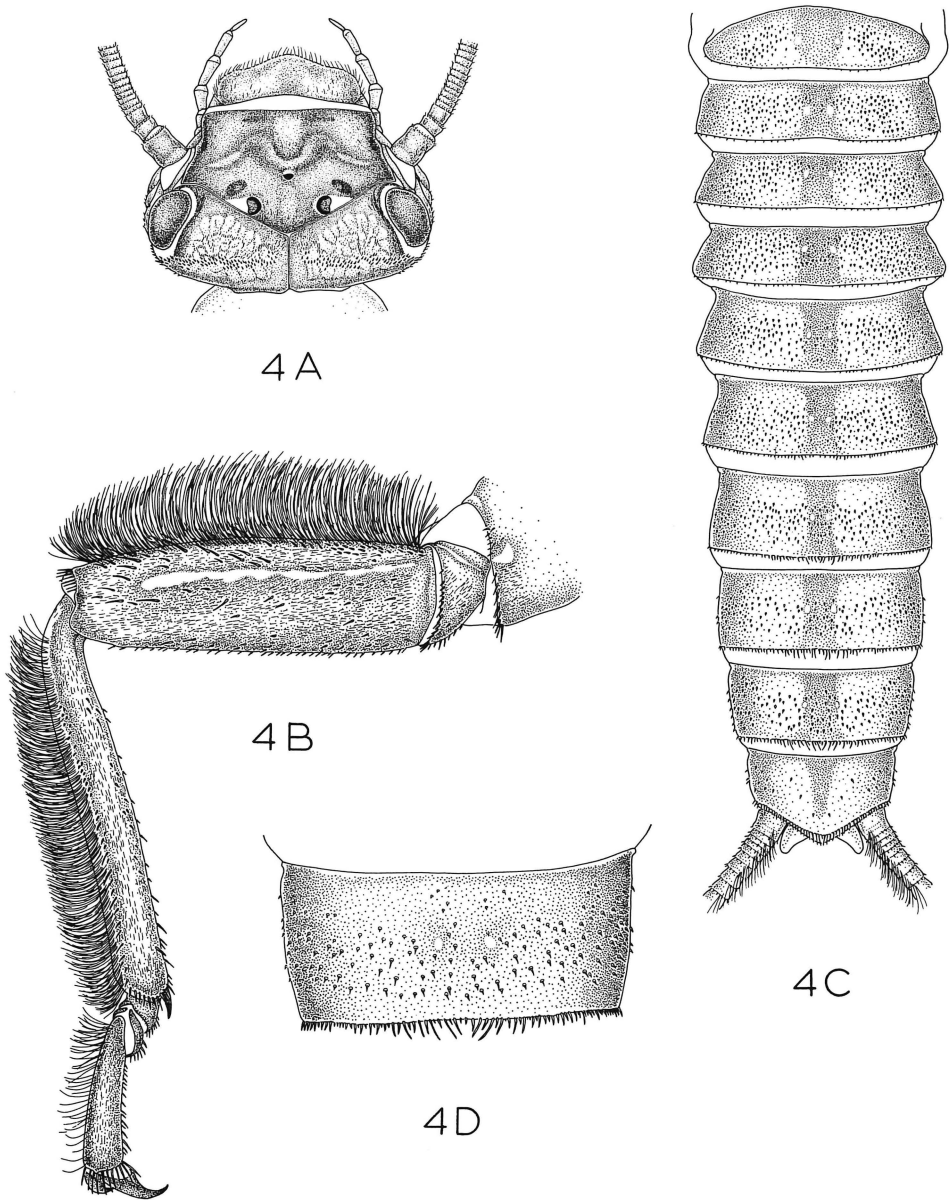


Figure 4. Nymphal characters of *Setvena tibialis*: A, dorsum head; B, right front leg (anterior); C, dorsum abdomen; D, dorsum Ab₉.

4 small yellow spots on the frons, narrow occipital spinule row curved forward and meeting on stem of ecdysial suture (Fig. 2A), short spinules on anterior margin of front legs (Fig. 2B), and short posterior row of blunt spinules on abdominal tergite (Fig. 2C, D).

S. bradleyi nymphs have a distinctive head pattern with falcate yellow spots anterolateral to lateral ocelli and a medial light bar forward of the light M marking

(Fig. 3A); the occipital spinule row is mostly single, not curved forward and meeting medially as in *S. wahkeena* (Fig. 3A). There are a few longer spinules adjacent to the femoral and tibial hair fringes of the front legs in addition to short spinules (Fig. 3A), and the posterior spinules of all abdominal tergae are long in a wide medial band (Fig. 3C, D), unlike those of *S. tibialis* and *S. wahkeena*.

Nymphs of *S. tibialis* do not have the distinct medial light bar anterior to M-line as in *S. bradleyi*, nor the light spots anterolateral to lateral ocelli present in both *S. bradleyi* and *S. wahkeena*. The occipital spinule row of *S. tibialis* is distinctive, being a band 2–4 wide, not meeting medially at the ecdysial stem (Fig. 4A). *S. tibialis* front legs have several long sharp hairs (Fig. 4B) and the posterior fringe of spinules (Fig. 4C, D) on abdominal tergae are intermediate between *S. wahkeena* (Fig. 2C, D) and *S. bradleyi* (Fig. 3C, D), and are sharp-tipped rather than blunt as in the other 2 species.

Material examined.—*Setvena bradleyi*—BRITISH COLUMBIA: Head of Gwillim Cr., Gladshelm Mossif, NW Slocum City, 22-VII-1958, John Ricker, ♂, ♀; 8.8 mi N Vermilion Lodge, 28-VI-1967, J. and R. Wold, 3 N. IDAHO: Lemhi Co., Wagonhammer Spring, 2 mi S North Fork, 28-V-1969, 6 N, 11-VI-1969, 2 ♂, B. R. Oblad, 23-VII-1979, K. Stewart, B. Stark, R. Baumann, 10 N. MONTANA: Glacier N.P., Avalanche Cr., 20-VII-1958, W. E. Ricker, 2 EX, Iceberg Cr., 27-VII-1965, A. R. Gaufin, ♂; Gallatin Co., Hyalite Cr., 10, 11-VII-1979, J. Fraley, 12 N; Ravalli Co., Str. below Lost Trail Pass, 8-VIII-1979, J. Fraley, 3 N; Lake Co., Crane Cr., 2 mi S Bigfork, 20-VI-1981, 19 N, Boulder Cr., E Shore Flathead Lk., 21-VI-1981, 7 N, Teepee Cr., 12 mi S Big Fork, Hwy 35, 21-VI-1981, 8 N, 26-VI-1981, ♀ (reared), N, K. Stewart, B. Shepard. OREGON (New State Record): Wallowa Mts., Trail to Horseshoe Lake, 10-VII-1968, E. Evans, 2 N.

Setvena tibialis—OREGON: Grant Co., Onion Cr., Strawberry Mt. 7700 ft elev., 18-VII-1936, R. E. Rieder, 2 N; Mt. Hood, Trib of Salmon R., 5-IV-1964, S. G. Jewett, Jr., 2 N; Hood River Co., Mt. Hood, S of Parkdale, 11-VII-1968, E. Evans, 22 N, Mt. Hood Meadows, 13-VII-1979, K. Stewart, B. Stark, 2 N, ♂ (reared), Newton Cr., Hwy 35, 13-VII-1979, K. Stewart, B. Stark, 2 N; Clackamas Co., Mt. Hood, 3 mi blw. Timberline Lodge and Still Cr. C. G., 12-VII-1979, K. Stewart, B. Stark, 16 N. WASHINGTON: Pierce Co., Mt. Ranier N.P., Fish Cr., N, St. Andrews Cr., 19 N, Sm. str at Reflection Lk., 13-VII-1979, K. Stewart, B. Stark, N.

Setvena wahkeena—OREGON: Multomah Co., Wahkeena Falls, 30-VI-1957, S. G. Jewett, Jr., Paratype ♂; sm. str off S side Bridal Veil Scenic Rd., 0.5 mi W mile 18 and 1.5 mi W Wahkeena Falls, 1-IV-1983, K. W. Stewart, holotype ♂ (reared), 12 N (one a well-developed ♂ with cuticle separated and underlying genitalia fully developed).

KEY TO ADULT *SETVENA* MALES

1. Apex of lateral stylets not distinctly serrated (Fig. 1G, M), stylets slender and falcate in lateral view (Fig. 1E); sclerotized dorsal portion of epiproct slender (Fig. 1M) *bradleyi*
 Apex of lateral stylets with distinct teeth (Fig. 1C, D, I, J, K, O); sclerotized dorsal portion of epiproct robust (Fig. 1K, O) 2
2. Lateral stylets stout, strongly curved in side view (Fig. 1B), with a prom-

inent raised dorsal crest (Fig. 1C, D); epiproct with 2–4 short, stout hairs on median, dorsal carina (Fig. 1K, L) *wahkeena*
 Lateral stylets less strongly curved in side view (Fig. 1H), with low carina-like dorsal crest (Fig. 1H–J); epiproct without short, stout dorsal hairs (Fig. 1O, P) *tibialis*

KEY TO *SETVENA* NYMPHS

1. Head with distinct light medial bar anterior to M-pattern (Fig. 3A), occipital spinule row mostly single not meeting medially (Fig. 3A), long posterior fringe of blunt spinules on all Ab. tergae (Fig. 3C, D) ... *bradleyi*
 Head without anterior medial bar, occipital spinule row 2–4 wide and/or meeting medially at ecdysial stem; posterior spinule fringe very short on first 5 abdominal segments 2
2. Occipital spinule row 2–4 wide, not meeting medially (Fig. 4A), posterior spinules longer medially on segments 7–10 and with sharp tips (Fig. 4C, D) *tibialis*
 Occipital spinule row 1–2 wide, curved forward medially and meeting at ecdysial stem (Fig. 2A), posterior Ab. spinules mostly even length on Ab. segments, and with blunt tips (Fig. 2C, D) *wahkeena*

ACKNOWLEDGMENTS

We are indebted to Drs. R. W. Baumann, J. D. Lattin, B. P. Stark, S. W. Syczytko and W. E. Ricker who loaned us nymphs and adults for study, and to John Fraley and Dr. W. D. Shepard for help in field collecting.

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Scientific Note

Fedtschenkia anthracina (Ashmead) (Hymenoptera: Sapygidae) in Idaho: A New State Record¹

A male *Fedtschenkia anthracina* (Ashmead) from central Idaho was found in the University of Idaho Entomology Collection. The specimen data follows: 7 mi SE Challis, Custer Co., ID, 29-VI-1965, W. F. Barr collector. The specimen was identified by comparison with a published description (Pate, 1947, *Acta Zool. Lill.*, 4:396-402) and specimens of *F. anthracina* from Arroyo Seco, Monterey Co., Calif. in the author's collection.

This is the first report of *F. anthracina* and thus the subfamily Fedtschenkiinae, from Idaho. This constitutes a substantial range extension (approximately 480 km) since *F. anthracina* had previously been reported from California, Colorado, New Mexico and Washington (Krombein, 1979, *in* Krombein et al., *Cat. Hymen. Am. N. of Mex.*, Vol. 2, p. 1319).

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The Generic Placement of *Xixuthrus domingoensis* Fisher (Coleoptera: Cerambycidae: Prioninae)

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Abstract.—*Xixuthrus domingoensis* Fisher is transferred to *Mecosarthron*. The species is illustrated and diagnosed. A key to the genera of West Indian Prioninae is provided.

From a zoogeographic standpoint, *Xixuthrus domingoensis* Fisher (1932:1) (Figs. 1, 2) is perhaps the most intriguing species of West Indian Cerambycidae. The other members of *Xixuthrus* are Oriental, and suspicion that the Hispaniolan *X. domingoensis* might be an introduced species rather than the result of natural disjunction led me to examine the type on a recent visit to the National Museum of Natural History. I found instead that the species belongs in the Neotropical genus *Mecosarthron*, and should be known as *Mecosarthron domingoensis* (Fisher) NEW COMBINATION.

Mecosarthron differs from *Xixuthrus* by having the profemora longer than or subequal to the mesofemora in males (profemora shorter than mesofemora in *Xixuthrus*), the third antennomere distinctly shorter than the first (Fig. 1) (subequal in *Xixuthrus*), and the anterior margin of the pronotum acutely indented near the sides and in the middle (Fig. 1) (smoothly bisinuate in *Xixuthrus*). For a description of *Mecosarthron*, see Lameere (1903:318).

Mecosarthron domingoensis Fisher can be distinguished from *M. buphagas* Buquet (Brazil) and *M. gounellei* Lameere (Brazil) by the finely punctate pronotum with irregular, smoothly glabrous calli on each side of disk (Fig. 1). I have not seen the other described species of *Mecosarthron*, *M. tritomegas* Lameere (Brazil).

It still seems possible that this species was introduced into Hispaniola. The other known members of the genus occur in Brazil, and I do not know of any specimens of *M. domingoensis* collected since the original description. Since two specimens exist, from different localities, seven years apart, and obtained by different museums, mislabeling seems out of the question. However, that such a large species, so disjunct from its congeners, would go uncollected for so long, raises the possibility that the collections were the result of an adventive population that may have subsequently disappeared from Hispaniola.

Mecosarthron can be distinguished from other genera of West Indian Prioninae by the characters listed in the following key.

KEY TO THE GENERA OF PRIONINAE OF THE WEST INDIES

1. Prosternal process rounded or truncate behind; mesosternum normal; eyes coarsely faceted 2

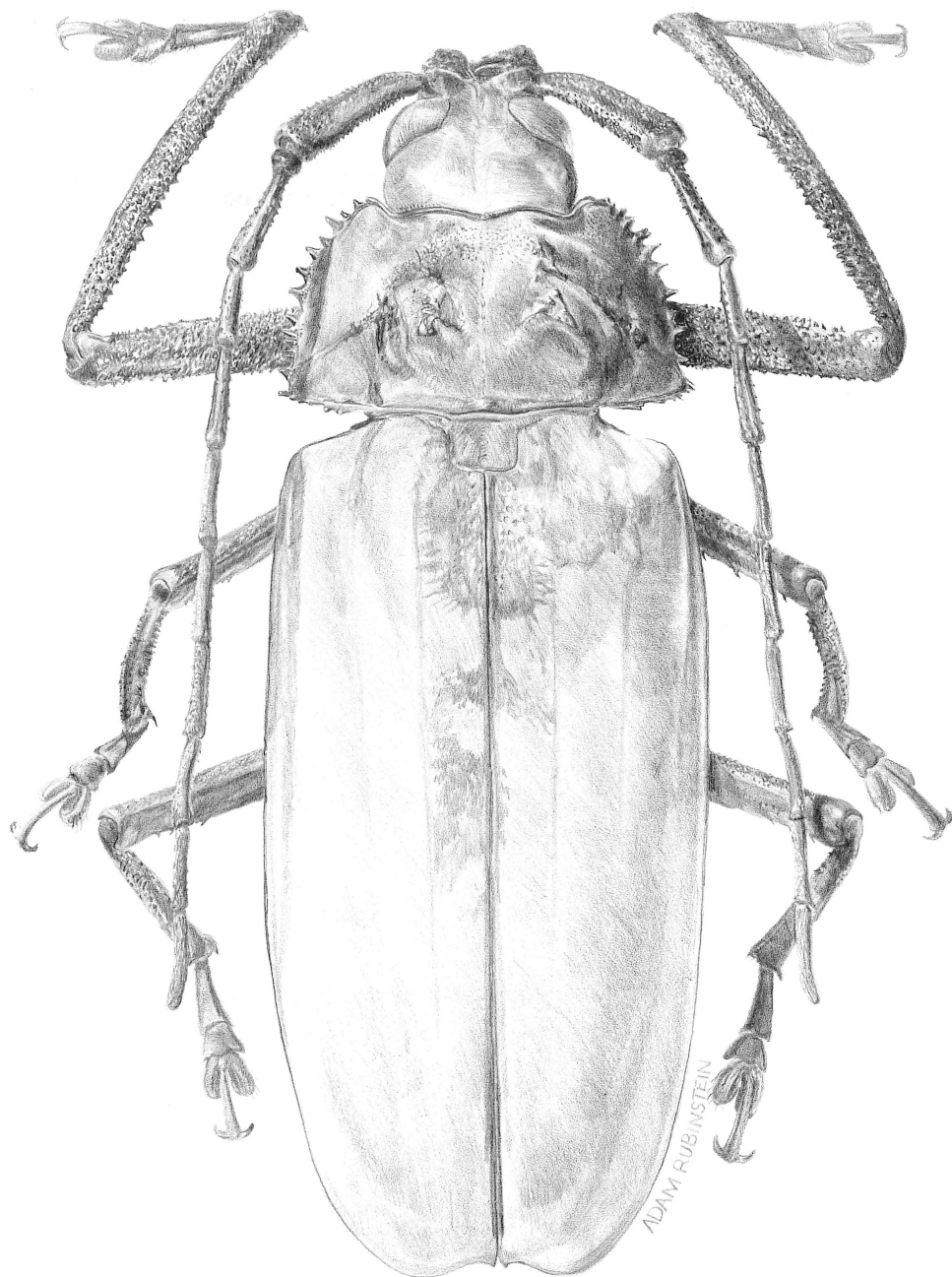


Figure 1. *Mecosarthron domingoensis* (Fisher), holotype: habitus.

- Prosternal process emarginate behind to receive mesosternal process; eyes
finely faceted *Derancistrus* Serville
2. Third antennal segment 1.5 or more times longer than the scape (Fig. 3) 3
- Third antennal segment subequal to or shorter than scape 6

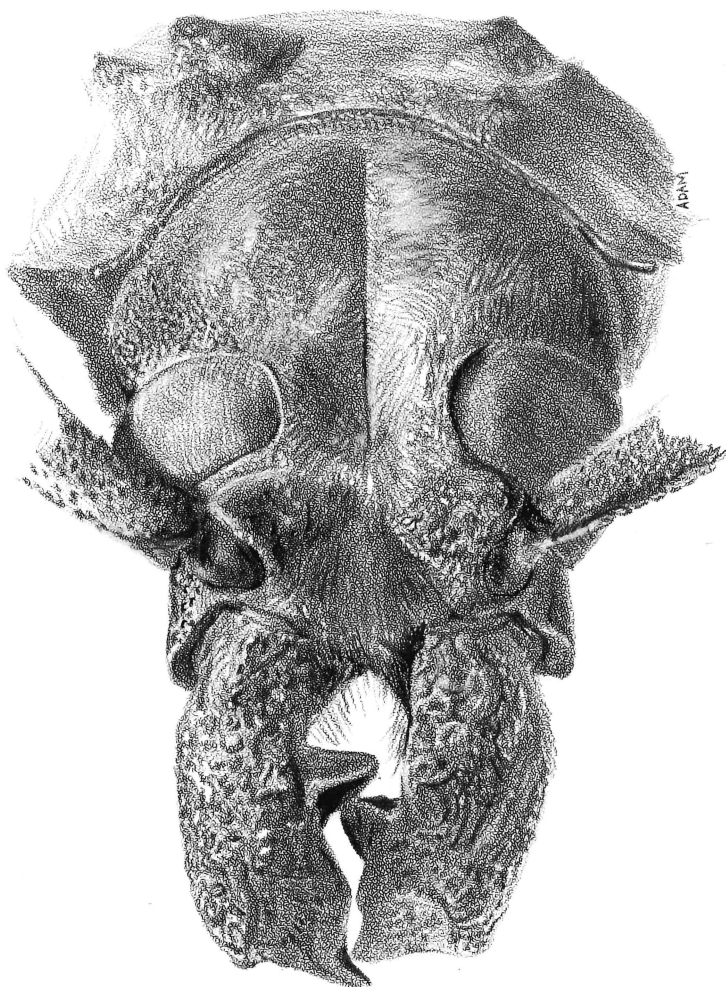
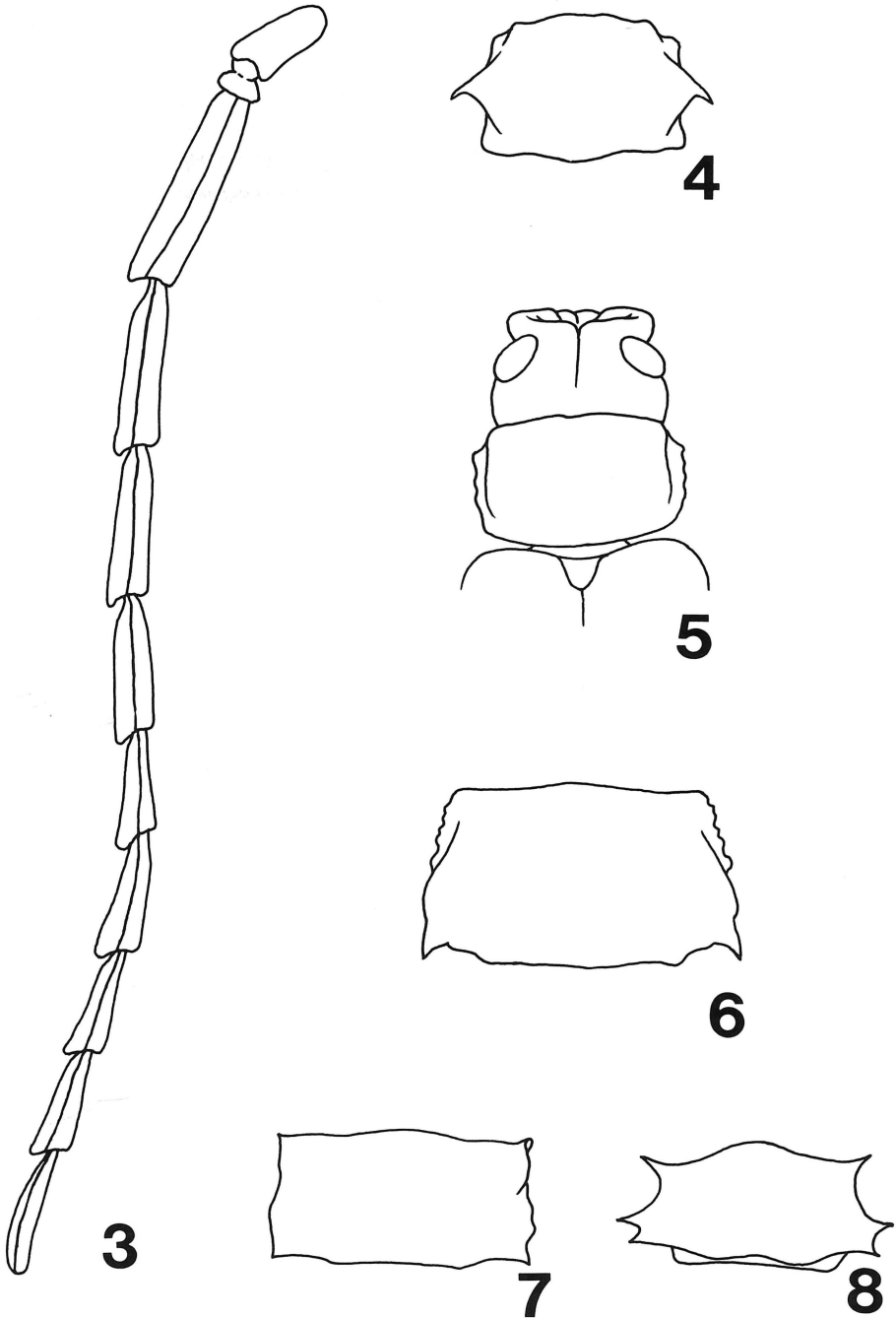


Figure 2. *Mecosarthron domingoensis* (Fisher), holotype: frontal view.

3. Antennae sub-serrate (Fig. 3); pronotum with a large curved spine medio-laterally (Fig. 4) *Monodesmus* Serville
Antennae filiform; pronotum not as above 4
4. Head nearly as wide as pronotum and elytra (Fig. 5); third antennomere not reaching basal half of pronotum; metepisternum narrowed posteriorly to a point *Anacanthus* Serville
Head distinctly narrower than pronotum and elytra; third antennomere reaching beyond base of pronotum; metepisternum truncate behind .. 5
5. Elytra smooth; antero-lateral angle of pronotum usually acute; epistoma distinctly pubescent *Callipogon* Serville (part)
Elytra asperate; antero-lateral angle of pronotum rounded or obtuse (Fig. 6); epistoma bare or with few scattered setae *Strongylaspis* Thomson
6. Pronotum of male quadrate, anterior margin nearly straight, all angles nearly right (Fig. 7); female pronotum armed laterally with 3-5 large



Figures 3–8. 3, 4. *Monodesmus* sp., Andros Is. 3, antenna; 4, pronotum. 5. *Anacanthus ruber* (Thunberg), Jamaica: head and pronotum. 6. *Strongylaspis corticaria* (Erichson), Panama: pronotum. 7, 8. *Cubaecola hoploderoides* Lameere, pronota. 7, male; 8, female (redrawn from Zayas, 1975: lamina 2c, 2d).

- spines, width across anterior pair equal to width at basal pair (Fig. 8);
 elytra pubescent *Cubaecola* Lameere
 Pronotum of male with anterior margin emarginate, angles projecting forward, acute, rounded, obtuse, spiniform or dentate; elytra variable ... 7
 7. Mandible rounded above, rugose laterally, strongly curved downward in male (Fig. 2); femora and protibiae multi-spinose below
 *Mecosarthron* Buquet
 Mandible carinate above, smooth laterally, not curved downward in male;
 femora and tibiae smooth on inner margin 8
 8. Elytra dull, pubescent; anterio-lateral angle of female pronotum acute ..
 *Callipogon* Serville (part)
 Elytra shining, glabrous; anterio-lateral angle of female pronotum rounded
 or obtuse *Stenodontes* Serville

For distributions of genera of Prioninae in the West Indies, see Chemsak and Linsley (1982), with the addition of *Anacanthus ruber* (Thunberg) from Jamaica (new record, in Florida State Collection of Arthropods and my collection) and Guadeloupe (Villiers, 1980:152).

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I am indebted to T. J. Spilman (National Museum of Natural History, Washington) and R. M. Quentin (Museum National d'Histoire Naturelle, Paris) for access to the types of the *Mecosarthron* species and other valuable material in their care; to B. Beck and R. Woodruff (Florida State Collection of Arthropods, Gainesville) for the loan of material; to A. Rubinstein and L. Shoemaker for preparing the illustrations; and to C. A. Triplehorn and J. A. Chemsak for a critical review of the manuscript.

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Scientific Note

Notes on the Use of Spadices of *Washington filifera* (Wendl) by *Xylocopa californica* (Cresson) (Hymenoptera: Apoidea)¹

The Southern California carpenter bee, *Xylocopa californica* Cresson, is known to nest in the trunks of the desert fan palm, *Washingtonia filifera* Wendl (Hurd, 1978, an annot. cat. of the carpenter bees of the West. Hem., Smith. Inst. Press, Washington, D.C.). Although the species has not been observed to construct its own entrance tunnels into the trunks, females are known to enter the exit holes of the giant palm boring beetle, *Dinapate wrightii* (Horn). They have been observed remaining in the holes for at least one-half hour and no doubt the females enlarge these holes for nesting.

Recently, Ron Grunt of Twentynine Palms, California, brought me several shed spadices of *W. filifera*. He had picked them up off the ground in the western (and privately owned) portion of the Oasis of Mara, San Bernardino County, California. Typically, the spadices of this species of palm are approximately 3.5 m long, develop between two and five hundred thousand 6 mm-diameter-flowers and are from 4 to 10 cm wide at their proximal end. These usually break off within two years after fruit production. A loud buzzing from within the spadices caused Grunt to inspect them at which time he discovered dime-sized holes in the proximal ends of approximately 20% of them. Within minutes after he picked them up numerous specimens of *X. californica* flew from the holes.

He brought me ten spadices for examination on March 12, 1984. All of them had tunnels starting from where the spadices had broken off from the tree and running from 7 to 38 cm toward the tip. One stalk had three tunnels. The entrance holes had a mean diameter of 15 mm. Each contained from five to twelve mature carpenter bees identified as *X. californica*.

Two stalks were cut lengthwise revealing 12 and 13 discolored ridges that appeared to indicate larval chambers. Grunt believed the bees hibernated in these tunnels for adults were found in spadices during winter and were observed leaving them in the spring.

The grove at the east end of the Oasis of Mara is dense, significantly disturbed and sits around and in a small motel complex. The trees receive fault-associated groundwater that nearly reaches the surface and irrigation from domestic watering. The spadices had been on the ground for approximately two years and, in general, were wider at their base than spadices produced by trees in undisturbed settings.

I checked spadices from nine other undisturbed palm groves in the Colorado Desert of southeastern California and could not find additional *Xylocopa* tunnels except at Mortero palms in Anza-Borrego Desert State Park in San Diego County, California. This grove was similar to the western portion of the Oasis of Mara in that the trees were so dense that the center of the oasis received little or no sunlight. Approximately 10% of the spadices had been burrowed into by carpenter bees in

¹ Supported by a grant from the Richard King Mellon Foundation to the Palm Springs Desert Museum.

the same manner as at Mara. I cut two of these lengthwise revealing five adult and two larvae in the first and two adult and six larvae in the second.

Carpenter bees are common in some palm groves. They are seen entering palm boring beetle exit holes and also at the flowers in June and July. Often, the bees destroy the ovaries as they feed on the nectar. To my knowledge, the utilization of fallen palm spadices for nesting chambers, and perhaps as hibernaculums, has not been previously noted. That they utilize them in this manner is not surprising—most desert plants do not have trunks or branches of sufficient girth to meet the nesting requirements of *Xylocopa*. Why then are the spadices not used in every palm oasis? I suspect the rarity of this technique may be due to the fact that the vast majority of the dead flower stalks either fall into direct sunlight, making them thermally unsuitable, or into the paths of floodwaters. All of the spadices which were, or had been, occupied by *Xylocopa* were in constant or at least abundant shade and not subject to being washed away by floods as so often occurs in canyon oases. Only dense stands of *W. filifera* not subject to floods are likely to provide the necessary conditions.

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**The Subgenus *Pseudoferonina* Ball
(Coleoptera: Carabidae: *Pterostichus*): Description of
Three New Species with a Key to All Known Species**

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Abstract.—Adults of three new species of the subgenus *Pseudoferonina* Ball (genus *Pterostichus* Bonelli) are described: *P. vexatus* Bousquet from Oregon, *P. smetanai* Bousquet from Washington and *P. campbelli* Bousquet from Oregon. A key to, and drawings of the median lobe of the aedeagus of, all known species of the subgenus are provided. The subgeneric name *Melvilleus* Ball (type-species: *Pterostichus shulli* sensu Ball, nec *Platysma shulli* Hatch = *Pterostichus vexatus* Bousquet, by original designation and monotypy) is considered as a junior subjective synonym of *Pseudoferonina* (NEW SYNONYMY).

The subgenus *Pseudoferonina* was proposed by Ball (1965) for two species, *P. lanei* Van Dyke and *P. humidulus* Van Dyke, previously assigned to the subgenera *Feronina* Casey and *Cryobius* Chaudoir respectively. In the same paper, Ball erected the subgenus *Melvilleus* for one species, which he misidentified as *P. shulli* Hatch, externally similar to those of *Pseudoferonina* but differing by some character states of the median lobe of the aedeagus.

The purpose of this paper is to describe the adults of three new species of *Pseudoferonina* and to provide a key to, and drawings of the median lobe of the aedeagus of, all known species. Members of the subgenus occur in western North America, specifically in the states of Idaho, Oregon and Washington.

Abbreviations used for the locations of the material studied are: CAS, California Academy of Sciences, San Francisco; CM, Carnegie Museum, Pittsburgh; CNC, Canadian National Collection, Ottawa; OSU, Oregon State University, Corvallis; UI, University of Idaho, Moscow.

***Pterostichus vexatus* Bousquet, NEW SPECIES**

Pterostichus shulli: Ball, 1965:110 (nec Hatch, 1949).

Description.—*Coloration*: dorsal surface of body, antennae and legs rufobrunneous, palpi rufous. *Microsculpture*: frons with isodiametric meshes; pronotum and elytra with moderately transverse meshes. *Pronotum* (Fig. 2): sides oblique in posterior half; anterior angles moderately produced; posterior angles obtuse; outer laterobasal impressions clearly impressed; inner laterobasal impressions punctate. *Legs*: mesotibia of male slightly curved apically (as in Fig. 5). *Abdomen*: last exposed sternum of male without secondary sexual characters. *Aedeagus* (Fig. 7): left side of apical portion of median lobe (in left lateral aspect) straight; apical portion of median lobe (in ventral aspect) without lightly sclerotized diagonal band.

Length of body: 9.0 mm.

Type material.—Holotype (male). *Idaho*: "Harvard, Ida. VII.22.'34 Bryant, 8./Pter. (Melvilleus) shulli Hatch det. George E. Ball." The specimen, which is deposited in the California Academy of Sciences, San Francisco, is complete but has the abdomen, part of the metathorax and right leg glued on a plate pinned with the specimen.

Distribution.—The species is known only from the type locality in Idaho. However, I have seen 1 male and 1 female, in OSU, labelled "Amda, Id. 7-22-1934 LT Turney" that probably belong to this species. Unfortunately, the aedeagus of the male is missing.

Remarks.—Adults of *P. vexatus* are very similar to those of *P. shulli* and *P. lanei* but differ mainly by the shape of the median lobe of the aedeagus (Fig. 7a) and the absence of a lightly sclerotized band on the ventral side of the median lobe (Fig. 7c).

Ball (1965) erected the monotypic subgenus *Melvilleus* for this species, which he misidentified as *P. shulli*, pointing out that it "is most similar to the species of *Pseudoferonina*, but the males are readily separated on the basis of the genitalic characteristics . . ." However, I am unable to find any character states, even in the male genitalia, which would justify a subgeneric separation for that species. The morphological differences in the median lobe between *P. vexatus* and the other species of *Pseudoferonina* are comparable to those found between species of subgenera like *Leptoferonina* Casey and *Hypherpes* Chaudoir. Furthermore, members of *P. vexatus* are synapomorphic with those of *P. shulli* and *P. lanei* in having the mesotibia of the male slightly curved apically (Fig. 5).

Based on the above facts, I consider the name *Melvilleus* Ball (type-species: *Pterostichus shulli* sensu Ball, 1965, nec *Platysma shulli* Hatch, 1949 = *Pterostichus vexatus* Bousquet, by original designation and monotypy) as a junior subjective synonym of *Pseudoferonina* Ball (NEW SYNONYMY).

The drawing of the median lobe listed as that of *P. shulli* in Hatch (1953, Plate III, Fig. 15a-c) is that of *P. vexatus*.

Etymology.—The specific name is the Latin adjective *vexatus*, -a, -um (maltreated); it refers to the fact that the species has been misidentified in the past.

***Pterostichus smetanai* Bousquet, NEW SPECIES**

Description.—*Coloration*: dorsal surface of body piceous to black, elytra slightly iridescent, basal antennomeres, palpi, epipleura and legs rufobrunneous to piceous. *Microsculpture*: frons with isodiametric meshes; pronotum with moderately transverse meshes, feebly impressed on disc; elytra with very transverse meshes. *Pronotum* (Fig. 3): sides sinuate in posterior half; anterior angles strongly produced; posterior angles slightly acute to right; outer laterobasal impressions impressed; inner laterobasal impressions slightly punctate. *Legs*: mesotibia of male straight (Fig. 6). *Abdomen*: last exposed sternum of male with shallow depression medially. *Aedeagus* (Fig. 11): left side of apical portion of median lobe (in left lateral aspect) strongly sinuate near middle and slightly sinuate subapically; apical portion of median lobe (in ventral aspect) with lightly sclerotized diagonal band.

Length of body: 8.2–8.5 mm.

Material.—Holotype (male). *Washington*: "Wash. Mt. St. Helens Spirit Lk., Bear Crk. 3200', 6.VII.74 A & D Smetana." The specimen, which is housed in

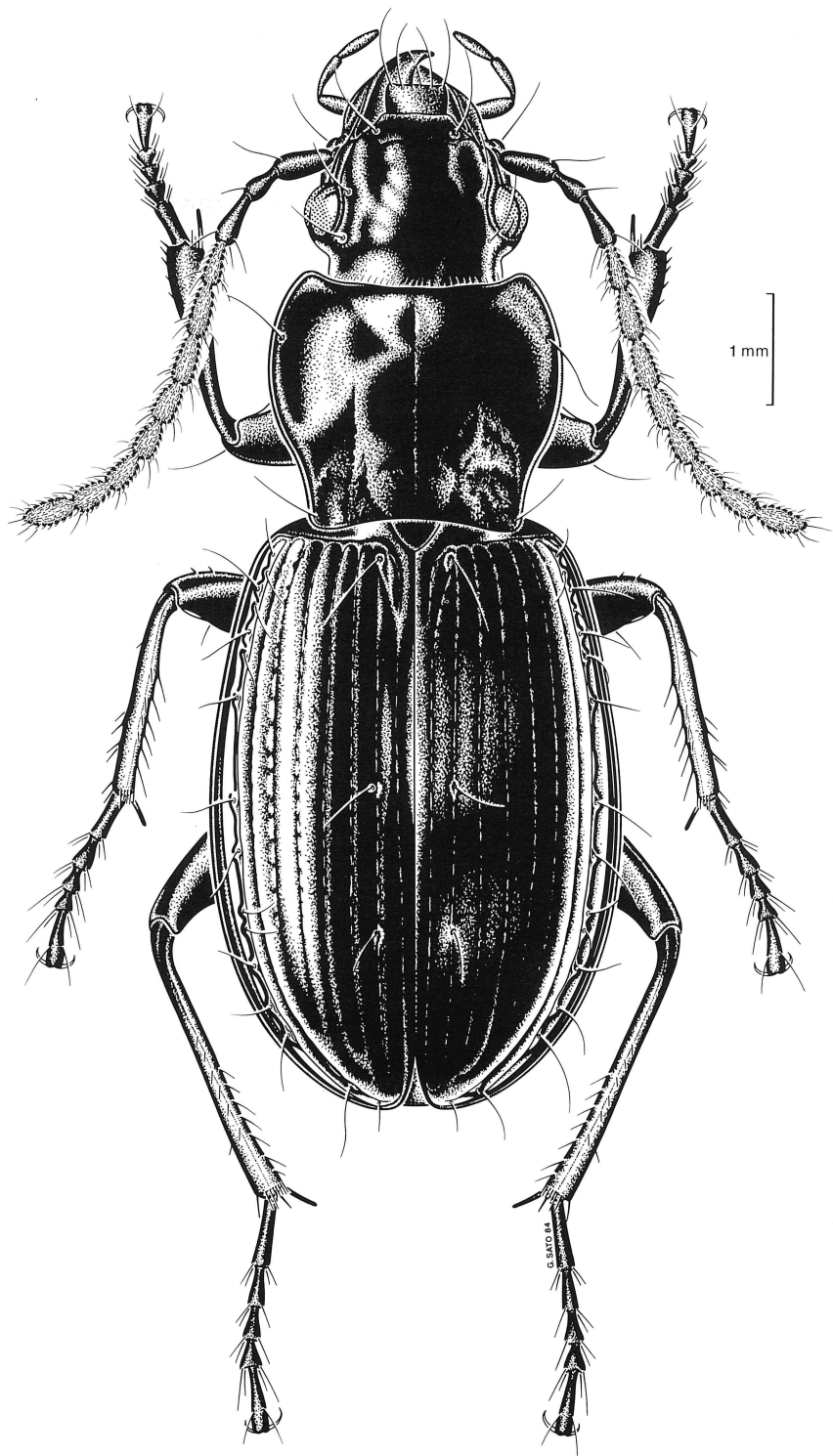
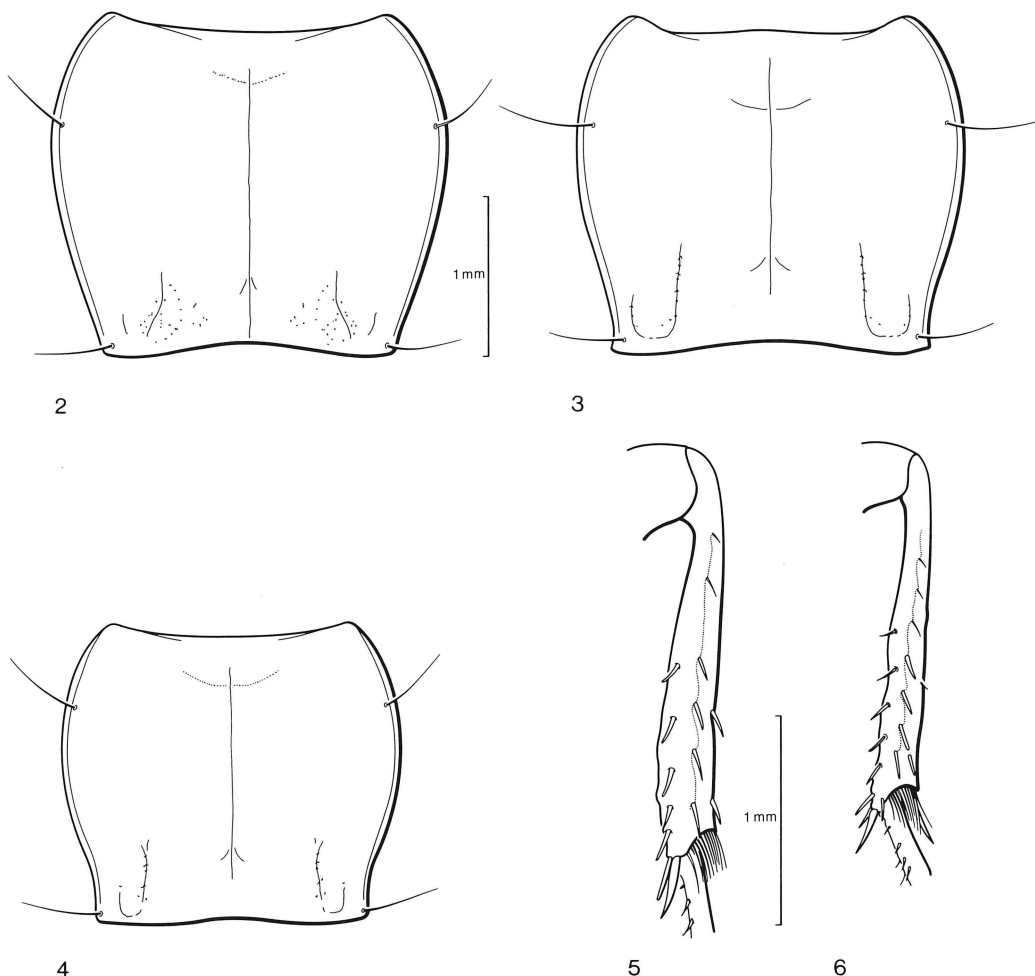


Figure 1. *Pterostichus smetanai* Bousquet, new species.



Figures 2–6. 2–4. Pronotum. 2, *P. vexatus*; 3, *P. smetanai*; 4, *P. campbelli*. 5, 6. Mesotibia of male (dorsal aspect). 5, *P. lanei*; 6, *P. smetanai*.

the Canadian National Collection (CNC No. 18400), has the last five (right) and seven (left) antennomeres and the tibia and tarsus of the left posterior leg missing.

Paratypes. *Washington*: same data as holotype (CNC), 2 females.

Distribution.—*Pterostichus smetanai* is known only from the type locality in Washington.

Habitat.—The three known specimens were collected at a wild creek on a steep forested slope on shaded, wet places constantly sprinkled with water, under rocks and pieces of bark on ground, together with adults of *Pterostichus johnsoni* Ulke and *Nebria* sp. (A. Smetana, pers. comm.).

Remarks.—Adults of this species are very similar to those of *P. campbelli* but differ by the shape of the median lobe of the aedeagus.

Etymology.—Patronymic, the species was named in honour of A. Smetana, Biosystematics Research Institute, Ottawa, who collected the specimens of the original series.



Figures 7–12. Right paramere (a), median lobe (left lateral aspect) (b) and apical part of median lobe (ventral aspect) (c) of aedeagus. 7, *P. vexatus* (holotype); 8, *P. shulli* (holotype); 9, *P. lanei* (holotype); 10, *P. humidulus* (holotype); 11, *P. smetanai* (holotype); 12, *P. campbelli* (holotype).

***Pterostichus campbelli* Bousquet, NEW SPECIES**

Description.—Similar to *P. smetanai* except for the following character states. **Pronotum** (Fig. 4): anterior angles less produced. **Aedeagus** (Fig. 12): left side of apical portion of median lobe (in left lateral aspect) slightly sinuate subapically.

Type material.—Holotype (male). **Oregon:** "Ore. Tillamook Co 1 mi S Hebo

28.VII.1979 JM & BA Campbell." The specimen is housed in the Canadian National Collection (CNC No. 18401).

Paratypes. *Oregon*: "Cannon Beach, Oregon VII-18-37" (CAS), 1 male, 1 female.

Distribution.—*Pterostichus campbelli* is known from Oregon but may also occur in Washington (see below).

In addition to the type material, I have seen 40 specimens, tentatively assigned to this species (see remarks), from the following localities: *Washington*: "Was." (CM), 1 ♂, 1 ♀. *Oregon*: Pacific City, 21.VII.42, K. M. Fender (OSU), 1 ♂; Alsea, 7.V.39, H. P. Lanchester (OSU), 1 ♂; Lobster Valley, 15 mi SW Alsea, 27.V.72, P. Lattin (OSU), 1 ♂; Bald Mt., Polk Co., 23.VIII.42 (OSU), 1 ♂; Mike Bauer Wayside, Lincoln Co., 30.VIII.81, 6.IX.81, J. R. LaBonte (CAS), 1 ♂, 2 ♀; Mike Bauer Park, Lincoln Co., 25.IX.81, P. J. Johnson (UI), 2 ♀; Grass Crk., Lincoln Co., 25.IX.81, P. J. Johnson (UI), 3 ♂, 7 ♀; nr. Canal Crk., Lincoln Co., 25.IX.81, P. J. Johnson (UI), 7 ♂, 7 ♀; Peavine Ridge, nr. McMinnville, 18.X.46, K. M. Fender (OSU), 1 ♀; Gualdo Falls, Yamhill Co., 30.VI.49 (OSU), 1 ♀; Boyer, 23.VII.41, K. M. Fender (OSU), 1 ♀; Latourell Falls, Multnomah Co., 8.V.37, M. H. Hatch (OSU), 1 ♀; Cannon Beach, 14.VII.37 (OSU), 1 ♀.

Habitat.—The holotype was collected by sifting deciduous leaf litter along a small stream (J. M. Campbell, pers. comm.). Some of the specimens studied have the following habitat labels: "sea drift after storm," "marshy area above river."

Remarks.—Adults of *P. campbelli* are very similar to those of *P. smetanai* and can be positively separated only by the examination of the median lobe of aedeagus.

Males assigned to *P. campbelli* show variation in the shape of the median lobe. Some specimens have the apical portion of the median lobe less sinuate apically and the apex more obliquely rounded (in left lateral aspect) than the holotype, while others have the apical portion of the median lobe more twisted than the holotype. I have not seen enough specimens of the subgenus to decide whether or not these morphological differences fall within the range of variation of *P. campbelli*. I have limited the type material to the specimens mentioned because of the possibility that the additional material studied may include more than one species.

The drawing of the median lobe listed as that of *P. humidulus* in Ball (1965, Fig. 4) is that of *P. campbelli*.

Etymology.—Patronymic, the species was named in honour of J. M. Campbell, Biosystematics Research Institute, Ottawa, who collected the holotype.

DISCUSSION

In addition to the three species described here, the subgenus *Pseudoferonina* includes three more species: *P. shulli*, *P. lanei* and *P. humidulus*. These species can provisionally be placed into 2 groups. Members of the first, which includes *P. vexatus*, *P. shulli* and *P. lanei*, are characterised by having the sides of the pronotum oblique (Fig. 2) or slightly sinuate in the posterior half, and the mesotibia of male slightly curved apically (Fig. 5). The species occur east of the Cascade Range, in Washington and Idaho. Members of the second group, which includes *P. humidulus*, *P. smetanai* and *P. campbelli*, differ by having the sides of the pronotum clearly sinuate in the posterior half (Figs. 3, 4), and the mesotibia

of male straight apically (Fig. 6). The species occur in the Pacific coast area and the Cascade Range, in Washington and Oregon. While the first group of species is probably monophyletic, as its species share the synapomorphy related to the form of the mesotibia of the male, I was unable to find any evidence suggesting that this is also the case for the second group of species.

Members of species of each group are very similar to each other externally and can be distinguished with confidence only by examination of the median lobe of the aedeagus. Adults of these species differ from those of other groups of *Pterostichini* (sensu stricto), occurring in Western North America, by the following combination of character states: microsculpture of elytra transverse; third interval of elytra with 2 discal setae; metacoxa with 2 setae (both laterad); seta on meta-trochanter present; metepisterna subquadrate (medial and anterior margins sub-equal in length).

The following key should enable students to separate adults of the species of *Pseudoferonina*.

KEY TO ADULTS OF THE SPECIES OF *PSEUDOFERONINA* BALL

1. Mesotibia of male slightly curved apically (Fig. 5). Sides of pronotum oblique (Fig. 2) or slightly sinuate in posterior half 2
 - Mesotibia of male straight apically (Fig. 6). Sides of pronotum clearly sinuate in posterior half (Figs. 3, 4) 4
2. Median lobe of aedeagus in ventral aspect without lightly sclerotized diagonal band (Fig. 7c) *P. vexatus* Bousquet
 - Median lobe of aedeagus in ventral aspect with lightly sclerotized diagonal band (Figs. 8c-9c) 3
3. Median lobe of aedeagus in left lateral aspect strongly sinuate behind middle (Fig. 8b). Outer laterobasal impressions of pronotum impressed ..
 - *P. shulli* Hatch, 1949
Known only from Idaho. Specimens studied: holotype (male) and allotype (female) with label "Pierce Idaho May 23, 1929 Alt 3200 W. E. Shull Collector" in OSU.
 - Median lobe of aedeagus in left lateral aspect not sinuate behind middle (Fig. 9b). Outer laterobasal impressions of pronotum absent or faintly impressed *P. lanei* Van Dyke, 1925
Known from Washington and Idaho. Specimens studied: holotype (male) with label "Wawawai, Wash. May 31, 1921 M. C. Lane Col." in CAS; 4 specimens with label "Idaho, Boise Co. 10 mi NE Idaho City, 10-Mile cmpdg., 18.VII.1981, J. M. Campbell" in CNC.
4. Last exposed sternum of male with 2 median protuberances. Apex of median lobe of aedeagus with a right projection (in left lateral aspect) (Fig. 10b) *P. humidulus* Van Dyke, 1943¹
Known only from Washington. Specimens studied: holotype (male) with label "Hoquiam Wash. V-27-1914 E. C. Van Dyke Collector" in CAS; one male (teneral) with label "Nasel R. Wash Pacific County Sept.9.1929" in OSU.
- Last exposed sternum of male without protuberances. Apex of median lobe of aedeagus without projection (in left lateral aspect) (Figs. 11b-12b) . . 5

¹ First described as *Pterostichus pacificus* Van Dyke, 1926, nec *P. pacificus* Poppius, 1906.

5. Median lobe of aedeagus in left lateral aspect sinuate near middle (Fig. 11b) *P. smetanai* Bousquet
 Median lobe of aedeagus in left lateral aspect not sinuate near middle (Fig. 12b) *P. campbelli* Bousquet

ACKNOWLEDGMENTS

I thank D. Lattin of the Oregon State University, D. Kavanaugh of the California Academy of Sciences and P. J. Johnson of the University of Idaho for sending me specimens used in this study, and my colleagues A. Smetana and I. Smith for their criticisms of the manuscript. I also acknowledge Go Sato for the preparation of the habitus illustration and for inking the line drawings.

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Scientific Note

Euparagia scutellaris Cresson (Hymenoptera: Masaridae) in Idaho: A New State Record¹

Species in the genus *Euparagia* Cresson have been reported from Arizona, California, Nevada, New Mexico, Texas and northern Mexico. All of the species except *E. scutellaris* Cresson appear to be restricted to desert regions. *Euparagia scutellaris* has been reported only from California where it occurs in the Transitional Zone (Krombein, 1979, in Krombein et al., Cat. Hymen. Am. N. Mex., Vol. 2, p. 1470). The collection of two specimens of *E. scutellaris* in south-central Idaho constitutes a range extension of approximately 500 km. The specimens were identified using key criteria (Bohart, 1948, Pan-Pac. Ent., 24:149-154) and by comparison with specimens of *E. scutellaris* from Sagehen Creek, Nevada Co. and Yuba Pass, Sierra Co., Calif. in the author's collection.

Specimens of *E. scutellaris* examined: Idaho: 1 ♂ Twin Falls Co., 11 mi E Rogerson, 20-VII-1952, W. F. Barr; 1 ♀ Camas Co., Corral, 11-VII-1983, J. B. Johnson, on *Lupinus* sp. Both specimens were deposited in the University of Idaho Entomological Museum.

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¹ Published with the approval of the director of the Idaho Agricultural Experiment Station as Research Paper No. 8478.

Scientific Note

Rhagoletis basiola in Apple: A New Host Record

Rhagoletis basiola (Osten Sacken) is a non-economic fruit fly which has been known to utilize only plants in the genus *Rosa*, and has the widest range of any *Rhagoletis* sp. in North America (Bush, 1966, Bull. Mus. Comp. Zool., 134(4): 431–562). In Oregon, we have captured it frequently on AM traps which are placed to detect apple maggot, *R. pomonella* (Walsh). Our work with the latter also has involved rearing.

On 26 August 1980, apples were collected from two adjacent trees growing on the slope below a railroad track in Gresham, Multnomah Co. (NW Sec. 4, T1S, R3E). During April 1981, two adults of *R. basiola* emerged in the lab. Adults of *R. pomonella* emerged also, but it is unknown if they were from the same fruits. On 13 October 1982, only a few deformed fruit remained on the same trees. These and (mostly) fruit on the ground were collected and yielded five pupae, all *R. basiola*, from which four adults emerged during June 1983. A large number of apples was collected from the same general area on 7 October 1983, yielding 17 pupae from which one *R. basiola* and a few *R. pomonella* adults emerged during 1984. The specimens of *R. basiola* have been deposited in the collections of the Oregon Department of Agriculture and Oregon State University.

During 1982 and 1983, Kevin Tracewski, Washington State University (pers. comm.) gathered 817 apples from the same area at various times, though it is unknown if any were from the aforementioned trees. These apples yielded 1179 pupae, from which no adults of *R. basiola* emerged.

The Gresham site is heavily infested with *R. pomonella* in both apple and naturalized hawthorn. A small stand of wild *Rosa* sp., which was found to be infested with *R. basiola* and an unidentified microlepidopteran in the hips, occurred about 50 meters from the known apple host(s); however, during the spring of 1983 these trees were destroyed by construction. Extensive rearing from apples collected at many other sites in western Washington and Oregon by Tracewski (pers. comm.) and the authors has not produced *R. basiola*, even when heavily infested *Rosa* spp. grew contiguously.

From these data and the fact it has not been reported elsewhere, it seems that the utilization of apple by *R. basiola* is rare. However, that this phenomenon exists may not be particularly surprising considering that *R. pomonella* is established on *Rosa rugosa* Thunberg in New England (Prokopy and Berlocher, 1980, Canadian Ent., 112(12):1319–1320). Flies in the genus *Rhagoletis* appear to be highly adaptable in exploiting new habitats and food resources (Bush, *ibid.*; 1969, Evolution, 23:237–251). It is hoped that the example we present does not augur additional problems for the apple industry.

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Scientific Note

Macrovelia hornii Uhler, a Cave-inhabiting Semiaquatic Bug (Hemiptera: Macroveliidae)¹

Macrovelia hornii Uhler is a widespread semiaquatic bug, previously recorded from Oregon, California, New Mexico, Nebraska to North Dakota, and Baja California, Mexico (Polhemus and Chapman *in* Menke (ed.), 1979, Bull. Calif. Insect Surv., 21:47). In California, the insect is found throughout the state, inhabiting stream margins, springs, and seep areas, usually where there is abundant vegetation (see Polhemus and Chapman for additional details).

During a recent trip to Redwood Canyon, Kings Canyon National Park, Tulare County, California, to explore caves for terrestrial arthropods, Thomas S. Briggs, Darrell Ubick, and I discovered *M. hornii* on the walls of Cedar Cave and Lilburn Cave. The bugs were most numerous in Cedar Cave (also known as Deep Cave), where they were first discovered on 16 August 1984. They occurred only in the twilight zone of the cave, from 2.5 m to 7.5 m from the entrance. The cave was cool, approximately 7°C (relative humidity 89%), compared with the estimated 26–29°C outside temperature at 1500 hours, and there was no standing or running water anywhere nearby. When four females were taken from the cave to the outside, they became torpid, an apparent response to the drastic change in temperature. The first collection yielded 1 male and 14 females; the second collection on the next day, 1 male and 4 females. In Lilburn Cave, 1 male and 3 females were collected. All individuals collected or seen were macropterous adults; no nymphs or brachypterous adults were present. No macroveliids were found in the third cave explored, May's Cave (also known as May's Hole).

We were not able to find any *M. hornii* individuals outside the caves in the immediate area during the short time we were there, but I would expect them to be present along the margins of Redwood Creek, which runs through Redwood Canyon. A female was found in a vegetated seepage hillside by D. Ubick on 17 August 1984 at 0.9 mile (0.5 km) south of Giant Forest Village, Sequoia National Park, Tulare County. This collection stop is 10.5 airline miles (17.5 km) due southwest of the Redwood Canyon area. The bug is also known from nearby Potwisha and Crescent Meadow; these records were taken from specimens in the collection of the California Academy of Sciences. Again, all these specimens are macropterous adults.

This cave record is the first for *Macrovelia hornii*, and it is the second for a semiaquatic bug in the Nearctic Region. Reddell (1970, Texas J. Sci., 22(1):47–65 and *in litteris*) recorded specimens of *Microvelia* sp. (Veliidae) from a pool at the bottom of Balcones Sink in Texas. Several species of *Microvelia* have been reported from caves in Africa, Central America, and other parts of the world. Gagné and Howarth (1975, Pacific Insects (1974), 16(4):399–413) described an apterous species *Speovelia aaa* Gagné and Howarth (now placed in *Cavaticovelia*), the world's first true troglobitic heteropteran, and recorded a species of troglophilic *Mesovelia* from Hawaiian lava tubes. Recent surveys of neotropical Mexican caves

¹ Note presented to the 19 October 1984 meeting of the Pacific Coast Entomological Society.

revealed that Hemiptera in caves are represented by mostly troglonexes and occasional troglophiles (1971, 1973, Assoc. Mex. Cave Stud. Bull., 3-5).

Macroveliids should not have been unexpected in caves since they tend to avoid light: they tend to rest under overhanging rocks or on vertical dark sides of stones (see Polhemus and Chapman). The presence of only adult macropters suggests that *M. hornii* are temporary inhabitants of caves. Until collections are made at other times of the year, no conclusions can be positively drawn regarding their permanent residency and reproduction in caves. However, Cedar Cave was discovered only recently in the early 1970's. At that time, the cave was completely filled with fluvial gravel deposits, indicating that Redwood Creek was higher than it is now. Through several excavations by spelunkers, the cave was first enlarged in 1974 and lengthened to the present length of about 370 meters of passage. Therefore, the bugs must have colonized the cave after the discovery of the cave. Since the specimens collected do not have cave-adapted modifications, the insects probably flew in from outside of the cave and did not colonize the twilight zone of the cave from within, i.e., from the Lilburn Cave system which probably has interstitial connections with Cedar Cave.

The writer gratefully acknowledges Dr. John C. Tinsley, Cave Research Foundation and U.S. Geological Survey, Menlo Park, California, for the opportunity to conduct the arthropod survey of the caves and for providing detailed information on the caves of the area; Mr. Stanley R. Ulfeldt, Trilobyte Computer Corp., Berkeley, California, for information on the history of Cedar Cave; Mr. Warren C. Rauscher, Belmont, California, for additional information; and Dr. John T. Polhemus, Englewood, Colorado, for critically reading the manuscript and confirming the identification of the insect.

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Scientific Note

Observations on Adult Behavior of *Centris flavofasciata* Friese (Hymenoptera: Anthophoridae)

A large nesting aggregation of *Centris flavofasciata* was discovered on December 13, 1980 north of Mazatlan, Sinaloa, Mexico. A few observations were made on the male bee behavior at the site and since two types of males were present, the author has been encouraged to record these observations for comparison with similar studies now in progress.

The nesting site was located at what was previously considered to be 5 miles north of Mazatlan but with the extensive development of the area, is now within the city limits. The location was just off the beach about 50 meters from the water line. The area was about 50×20 meters in size on a slight north facing slope. The substrate was very fine, loose sand with sparse clumps of prostrate plants at the edges. A great deal of trash (cans, bottles, plastic bags, etc.) was present in the vicinity.

The bees were first encountered at 11:50 AM on a bright sunny day. Hundreds of individuals were flying over the site a few centimeters above the surface. Two distinct types of males were present, one smaller and faster ("normal") and the other larger and slower ("beta").

The beta males were observed to land on the sand and walk about in a sort of searching behavior. Three or four more individuals would join the first and all clustered together for about a minute before dispersing and flying away. The normal males remained alone after landing and appeared to occupy a definite territory. Whenever a bee flew over another's territory, the owner would immediately take flight and pursue the intruder. Each type of male appeared to ignore the other and no contact between the two was observed. No digging activity was seen and all of the individuals flying over the site appeared to be males.

A normal male was observed mating at the edge of the site. The couple were on the sand near the plant cover. While the couple were still joined, the female flew a short distance and alighted on a small plant. During mating, the male held the female behind the head with his mandibles and held her body with his legs. The male remained in position even when not joined. After 2-3 minutes the male made a buzzing sound and flew away. The female primed for a few seconds and also flew away.

After an hour activity decreased and the number of bees flying over the site was reduced.

My thanks to R. Snelling for determining the bees and to G. Frankie for suggesting the publishing of the observations.

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Scientific Note

Bombus bifarius Foraging at Aphid Honeydew (Apidae)

On the morning of 21 September 1984, male and female *Bombus bifarius* Cresson were observed collecting honeydew from clusters of aphids, *Cinera curvipes* (Patch), feeding on white fir, *Abies concolor* (Gord. & Glend.). Approximately a dozen individuals were noted among aphid aggregations in Panther Meadows Campground, 2400 m, Mount Shasta, Siskiyou County, California. Activity was first noted at 0730 hours and continued until 0900 hours when the observations were terminated.

As many as three individuals were present per aphid cluster. Other associates at the honeydew included *Camponotus* workers, two syrphids, and a calliphorid. Yellow jackets (*Dolichovespula*) were also common around the honeydew accumulations, but were frequently driven off by the foraging bumblebees.

Although honeybees visit honeydew, this behavior is not well known among bumblebees; e.g., foraging at honeydew is not mentioned in Heinrich (1979, *Bumblebee economics*, Harvard Univ. Press, Cambridge, Mass., 245 pp.), Mitchell (1962, *Bees of eastern United States*, Vol. 2, North Carolina Agr. Exp. Stat. Tech. Bull., pp. 513–538), Plath (1934, *Bumblebees and their ways*, MacMillan Co., New York, 201 pp.), or Thorp et al. (1983, *Bumble Bees and Cuckoo Bumble Bees of California* (Hymenoptera: Apidae), Bull. Calif. Insect Survey, Vol. 23, Berkeley, Univ. of Calif. Press, 79 pp.). Three Palearctic species have been reported to occasionally collect honeydew: *B. lucorum* (L.), *B. terrestris* (L.), and *B. hypnorum* (L.) (Alford, 1975, *Bumblebees*, Davis-Poynter, London, p. 91; Free and Butler, 1962, *Bumblebees*, Collins, London, p. 91).

Bischoff (1927, *Biologie der Hymenopteren*, J. Springer, Berlin, p. 85) observed that *B. hypnorum* collected aphid honeydew in preference to visiting nearby *Rubus* flowers, a frequent nectar source for this species. Similarly, males of *B. bifarius* collected honeydew and ignored flowering *Chrysothamnus* (Nutt.), a frequent nectar source of *B. bifarius* (Thorpe et al., loc. cit.).

These observations lead to questions regarding resource utilization by bumblebees. It would be of interest to know if honeydew foraging is an opportunistic behavior occurring late in the season as flower resources disappear, or fall temperatures drop below minimums for nectar secretion (Crane, 1975, *Honey*, Heinemann, London, pp. 91–92). Alternatively, some individuals may be partial honeydew specialists throughout the life cycle of the colony, visiting honeydew early in the morning then switching to flowers later in the day.

David L. Wagner, *Department of Entomology, University of California, Berkeley, California 94720*; Sydney A. Cameron, *Department of Entomology, University of Kansas, Lawrence, Kansas 66045*.

Scientific Note

A Homonymy in the Genus *Trypoxylon* (Hymenoptera: Sphecidae)

In 1982 (Univ. Calif. Publ. Entomol., vol. 97, pp. 37–39) I described a large mud-daubing sphecid wasp that occurs in southern Mexico. I gave the name *Trypoxylon* (*Trypargilum*) *giganteum* Coville to the species. Recently, Dr. Alexander Antropov (of the Zoological Museum, Moscow State University, Herzen Street 6, Moscow 103009, USSR), who is cataloguing the species of *Trypoxylon*, kindly informed me that *giganteum* Coville is a junior homonym. Tsuneki (1980, Special Publ. Japan Hymenopterists Assoc. No. 13, pp. 123–126) had given the name *giganteum* to a species of *Trypoxylon* in the subgenus *Trypoxylon* that he described from the Philippines. Therefore, a replacement name for *giganteum* Coville is required. As a replacement name, I am proposing *Trypoxylon* (*Trypargilum*) *antropovi* in honor of Dr. Antropov for his discovery of the homonymy and graciously informing me of the need to replace the name.

Rollin E. Coville, *Division of Entomology and Parasitology, University of California, Berkeley, California 94720.*

Proceedings of the Pacific Coast Entomological Society, 1984

FOUR HUNDRED AND TWENTY-EIGHTH MEETING

The 428th meeting was held Friday, 20 January 1984, at 8:10 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Dr. Harvey I. Scudder presiding.

The minutes of the meeting held 16 December 1983 were read, corrected, and accepted. Mr. Gary L. Peters was proposed and elected as a regular member.

Mr. Vincent F. Lee read names of additional members of the Society who elected to be sponsoring members for 1984: Mr. Arthur L. Chan, Mr. Benjamin Keh, Dr. Edward L. Smith, and Mr. Roy R. Snelling. Dr. David H. Kavanaugh announced the rediscovery of the type of *Amphizoa davidi* Lucas in the Paris Museum, the unique specimen of the only known species of amphizoid from the Old World. He also announced that some boxes from the entomology department were available without charge. Dr. Scudder announced the titles and speakers of the forthcoming meetings.

The featured speaker Mr. David L. Wagner, University of California, Berkeley, gave the lecture entitled "The Mating and Flight Behavior of Ghost Moths (Lepidoptera: Hepialidae)." He showed slides and talked about the general biology of hepialids and specifically on two local species, *Hepialis hectoides* Boisduval and *H. californicus* Boisduval.

The social hour was held in the entomology conference room following adjournment of the meeting.

A total of 51 persons was present, of which 32 signed as members and 17 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND TWENTY-NINTH MEETING

The 429th meeting was held Friday, 17 February 1984, at 8:15 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Dr. Harvey I. Scudder presiding.

The minutes of the meeting held 20 January 1984 were read and accepted. Mr. Richard L. Hall was proposed and elected as a regular member.

Dr. Scudder reported on the status of the Society's participation with the American Association for the Advancement of Science meetings in June 1984. Several guests and students in the audience were introduced. Dr. Kirby W. Brown showed color slides of the green shield scale *Pulvinaria sidii* Maskell.

The featured speaker Dr. Robert K. Washino, chairperson of the Department of Entomology, University of California, Davis, gave the lecture entitled "Forecasting the Impact of Reclamation on Mosquito Fauna." He showed slides and talked about the history of California water projects and how they affect several well-known mosquito species. By using regression analysis of variables such as snowpack levels, temperatures in March and April, rice acreage, total insecticides, etc., predictions of mosquito populations of the 1950's through the 1970's fell fairly close to actual estimates, especially during years with normal weather.

The social hour was held in the entomology conference room following adjournment of the meeting.

A total of 49 persons was present, of which 31 signed as members and 18 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND THIRTIETH MEETING

The 430th meeting was held Friday, 16 March 1984, at 8:15 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President-elect Dr. J. Gordon Edwards presiding.

The minutes of the meeting held 17 February 1984 were read and accepted. Three persons were proposed and elected as new members: Mr. Eduardo A. C. de Almeida as a student member, and Dr. George C. Eickwort and Mr. John E. Holzbach as regular members.

Mr. Gary W. Ulrich presented Mr. Clifford Y. Kitayama's note on a new distribution record for *Megalodacne faciata* (Fabricius).

The featured speaker Dr. Elaine A. Backus, University of California, Davis, gave a lecture entitled "Sensory Mechanism of Feeding Behavior in Leafhoppers—A Matter of Good Taste." She talked about the feeding behavior of several species of leafhoppers. She also lectured on the stylet sensilla involved in proprioception and showed excellent scanning electron micrographs of precibarial sensilla.

that are thought to function as chemoreceptors. Speculation was made on the distribution and numbers of these sensilla as they relate to the feeding strategies of these leafhoppers.

The social hour was held in the Goethe Room following adjournment of the meeting.

A total of 20 persons was present, of which 11 signed as members and 9 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND THIRTY-FIRST MEETING

The 431st meeting was held Friday, 20 April 1984, at 8:15 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with Past President Dr. Edward L. Smith presiding.

The minutes of the meeting held 16 March 1984 were read and accepted. Seven persons were proposed and elected as new members: Mr. Randy W. Cohen as a student member, and Mr. Nicholas A. Kormilev, Mr. Delbert A. LaRue, Mr. Randall W. Lundgren, Dr. Elwood S. McCluskey, Dr. Edward L. Mockford, and Dr. Rüdiger Wagner as regular members.

Dr. Smith reminded the audience of the AAAS-PCES meeting in June 1984. He also commented on a financial problem of *The Pan-Pacific Entomologist*.

The featured speaker Dr. Jacqueline L. Robertson, Pacific Southwest Forest and Range Experiment Station, Berkeley, gave a lecture entitled "The Importance of Biotypes." She talked about biotypes of forest insects, with special reference to the douglas fir tussock moth and the western spruce budworm. The techniques of identification of biotypes, namely electrophoresis for esterase and bioassay for carbaryl, were described. The results of bioassay led to the speaker's conclusion that the previous history of exposure to pesticides was a common thread in the prediction of insect tolerance to carbaryl. The implication of biotypes on registration and use of pesticides were discussed.

The social hour was held in the Goethe Room following adjournment of the meeting.

A total of 34 persons was present, of which 23 signed as members and 11 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND THIRTY-SECOND MEETING

The 432nd meeting was held Friday, 18 May 1984, at 8:15 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Dr. Harvey I. Scudder presiding.

The minutes of the meeting held 20 April 1984 were read and accepted. Four persons were proposed and elected as new members: Mr. Steven V. Fend and Mr. Adam C. Messer as student members, and Dr. Donald L. J. Quicke and Mr. Jacques Rifkind as regular members.

Dr. Scudder circulated photographs of the Habsburg Emperor's Crown, which bore stylized insects and is housed in the Vienna Museum. He also reminded the audience about the AAAS-PCES meeting on 11 and 12 June 1984 and the "Computers in Systematics and Biogeography" seminar, which is also co-sponsored by the Society, that might be of interest to the members of the Society. Dr. Francis G. Howarth of the Bishop Museum and his wife Nancy were introduced by Dr. William E. Ferguson. Mr. Alec M. Balmy presented a note on the first record of the viceroy butterfly from Baja California, Mexico.

The featured speaker Mr. Fred C. Roberts, manager of the Alameda County Mosquito Abatement District, Oakland, presented a lecture entitled "The Use of Computers for Entomological Biodata." He talked about the microhabitats of mosquitoes in Alameda County and the techniques used by source reduction crews to sample and control mosquitoes in the source areas. The microcomputer system put together by ACMAD to handle biological data from the field and laboratory, climatic data, etc. was described. From these data, a model was created for prediction of mosquito population trends. A current research project on the relationship of mosquito fish, *Anopheles* larvae, and the sago pondweed was also described.

The social hour was held in the Goethe Room following adjournment of the meeting.

A total of 29 persons was present, of which 21 signed as members and 8 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND THIRTY-THIRD MEETING

The 433rd meeting was held Friday, 19 October 1984, at 8:10 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Dr. Harvey I. Scudder presiding.

The minutes of the meeting held 18 May 1984 were read and accepted. Thirteen persons were proposed and elected as new members: Mr. Andrew M. Amster, Mr. Derek K. Broemeling, Ms. Helen E. Carr, Mr. Jett S. Chinn, Mr. Liam Davis, Mr. J. Kenneth Grace, Jr., Mr. Peter M. Ozorio, and Mr. Kirk A. Smith as student members, and Dr. D. Christopher Darling, Dr. Mario Descamps, Mr. David J. Donahue, Dr. Henry A. Hespenheide III, and Dr. Dennis D. Murphy as regular members.

Dr. Scudder gave a brief summary of our Society's seminar "Topics in Entomology," held in affiliation with the Pacific Division of the American Association for the Advancement of Science meetings on 11 and 12 June 1984 at San Francisco State University, announced the June 1985 meetings to be held in Missoula, Montana, and mentioned the recent payment by the U.S. Department of Agriculture of past due publication charges. Dr. Paul H. Arnaud, Jr. announced with regret the passing on 11 June 1984 of Dr. Robert C. Miller, an honor member of the Society, who served as treasurer of the Society for 21 years and as a director of the California Academy of Sciences. Mr. Vincent F. Lee announced the existence of a youth-oriented entomology group Young Entomologists' Society (Y. E. S.), formerly the Teen International Entomology Group and presented a scientific note entitled "*Macrovelia hornii* Uhler, a Cave-inhabiting Semiaquatic Bug (Hemiptera: Macroveliidae)." Dr. Edward S. Ross presented slides of the New Forest Butterfly Farm, in Longdown, near Southampton, England. Dr. Stanley C. Williams presented a scientific note he co-authored with Dr. Jack T. Tomlinson entitled "Gathering of Aecial Spores of Willow Rust by the Honey Bee, *Apis mellifera* (Hymenoptera, Apinae)." Dr. Scudder announced the fall 1985 meeting of the World Health Organization, held in conjunction with the Fogarty International Center of the National Institutes of Health, at the Gorgas Memorial Laboratory in Panama. Mr. Lee also presented a news release from the Pacific Missile Test Range at Point Mugu, California, with a photograph showing technicians spraying for mosquito control.

The featured speaker Dr. Charles H. Schaefer, University of California Mosquito Research Laboratory, Fresno, presented "Experiences with Mosquito Control and Malaria in Indonesia." His slide-illustrated lecture showed how cultural practices of the Javanese people and the 1982 drought encouraged the growth of mosquitoes and maintenance of malaria. He also mentioned a project in which *Bacillus thuringiensis* Berliner serotype H14 was used to control mosquitoes in a lagoon.

The social hour was held in the entomology conference room following adjournment of the meeting.

A total of 45 persons was present, of which 22 signed as members and 18 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND THIRTY-FOURTH MEETING

The 434th meeting was held Friday, 16 November 1984, at 8:05 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Dr. Harvey I. Scudder presiding.

The minutes of the meeting held 19 October 1984 were read and accepted. Two persons were proposed and elected as new regular members for 1985: Mr. Harold A. Connelly and Mr. Robert B. Parks, Jr.

Dr. Scudder announced the formation of the auditing committee, consisting of Mr. H. Vannoy Davis as chairperson and Dr. Paul H. Arnaud, Jr. and Mrs. Helen K. Court as members, and the nominating committee, with Dr. Stanley C. Williams as chairperson and Drs. William A. Ferguson and Cornelius B. Philip as members. He also announced that the Academy is imposing a fee for the use of the Morrison Auditorium and Goethe Room for the Society meetings and solicited donations from the audience. Dr. J. Gordon Edwards introduced three students from San Jose State University. Dr. Scudder announced that the 1985 meetings of the Pacific Division of the American Association for the Advancement of Science will be held 9–14 June 1985 at the University of Montana, Missoula, with Dr. Jerry J. Bromenshenk as the local coordinator for the Society, and called for volunteers from the floor. Ms. Sharon S. Mead showed slides of a katydid she photographed in Costa Rica. Dr. Jack T. Tomlinson gave a scientific note he co-authored with Dr. Williams entitled "Antibiotic Properties of Honey Produced by the Domestic Honey Bee *Apis mellifera* (Hymenoptera: Apidae)."

The featured speaker Mr. Richard L. Tassan, Gill Tract, University of California, Albany, presented "Biological Control of Iceplant Scales in California." He lectured on the biologies of the iceplant scales *Pulvinariella mesembryanthemi* (Vallot) and *Pulvinaria delottoi* Gill and their spread in the landscaping along highways of California and on the attempts to control them with natural adelphid and encyrtid parasitoids and coccinellid predators imported from South Africa.

The social hour was held in the entomology conference room following adjournment of the meeting.

A total of 34 persons was present, of which 25 signed as members and 9 as guests.—V. F. Lee, Secretary.

FOUR HUNDRED AND THIRTY-FIFTH MEETING

The 435th meeting was held Friday, 14 December 1984, at 8:10 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Dr. Harvey I. Scudder presiding.

The minutes of the meeting held 16 November 1984 were read and accepted. Two persons were proposed and elected as new regular members for 1985: Ms. Lily Dong and Dr. Claire Levesque.

Dr. Scudder asked for committee reports. Dr. Paul H. Arnaud, Jr. summarized the audit committee's report and passed the report around for the audience to view. Mr. Vincent F. Lee reported for the membership committee, gave a summary of the size of the membership for 1984, and mentioned the successful sponsoring membership drive initiated this year. He then read the names of members who elected to be sponsoring members for 1985: Dr. Phillip A. Adams, Mr. Robert P. Allen, Dr. William F. Barr, Dr. Richard M. Bohart, Mr. and Mrs. Robert Buickerood, Dr. Donald J. Burdick, Dr. Leopoldo E. Caltagirone, Dr. Kenneth W. Cooper, Dr. J. Gordon and Alice Edwards, Dr. George R. Ferguson, Mr. Wayne C. Fields, Jr., Dr. Theodore W. Fisher, Dr. John G. Franclemont, Dr. Kenneth S. Hagen, Dr. Alice S. Hunter, Mr. Johannes L. Joos, Mr. Charles E. Kennett, Mr. Dennis M. Kubly, Dr. Robert J. Lyon, Dr. Robert L. Mangan, Mr. Gordon A. Marsh, Dr. Woodrow W. Middlekauff, Mr. Calvert E. Norland, Mr. Harry W. Oswald, Dr. Robert W. L. Potts, Dr. Jacqueline L. Robertson, Ms. Leslie S. Saul, Dr. Evert I. Schlinger, Mr. David B. Scott, Dr. Harvey I. Scudder, Dr. Terry N. Seenon, Mr. Frank E. Skinner, Dr. Edward L. Smith, Mr. Roy R. Snelling, Drs. Marius S. Wasbauer and Joanne S. Slansky, and Dr. David B. Weissman. On behalf of Treasurer Dr. Wojciech J. Pulawski, Dr. Arnaud thanked the President and Secretary for their part in getting payment for outstanding debts from the U.S. Department of Agriculture.

Dr. Stanley C. Williams read the 1985 slate of candidates from the nominating committee: President Dr. J. Gordon Edwards, Treasurer Dr. Wojciech J. Pulawski, Secretary Mr. Vincent F. Lee, and President-elect Mr. Larry G. Bezark. Dr. William E. Ferguson suggested that a restaurant be indicated on the meeting announcement for dinner before the regular meetings. The audience concurred with a show of hands. Dr. Williams suggested that the Society host an annual formal dinner. Mr. Larry G. Bezark gave a summary of the Entomological Society of America meeting in San Antonio. Dr. Williams introduced Mr. Louis Dubay and Mrs. Lenore Bravo of the San Francisco Beekeepers Association, and Mr. Benjamin Keh introduced Ms. Lily Dong. Dr. Scudder then past the gavel to the new president, Dr. J. Gordon Edwards. Dr. Kirby W. Brown presented 35 mm slides of tortricid and reduviid eggs. Dr. Edwards noted an old paper by Dr. Cornelius B. Philip and reminded the audience of his expertise in many aspects of medical entomology.

The featured speaker Dr. Scudder presented the presidential address "North American Tertiary Fossil Insects." He summarized the known Tertiary fossil sites in North America and in other areas in the Palearctic Region, with special emphasis on his studies of the paper shales of Stewart Valley, Nevada.

The social hour was held in the entomology conference room following adjournment of the meeting.

A total of 37 persons was present, of which 27 signed as members and 10 as guests.—V. F. Lee, Secretary.

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